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REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR 1903

PART III

THIRD REPORT OF THE STATE ENTOMOLOGIST

W. E. BRITTON, PH.D.

THIRD REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1903

BY

W. E. BRITTON, PH.D.

State Entomologist

New Haven, Conn.

1904

The Tuttle, Morehouse & Taylor Company
New Haven, Conn.

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ILLUSTRATIONS.

The illustrations in this report are from the following sources:

Plates I, II, III a, IV b, V b, VI a and b, and VIII are from photographs taken by B. H. Walden.

Plate VII is from a photograph taken by the late Mr. H. A. Doty.

Plate III b, IV a, V a, and VI c, are from photographs taken by W. E. Britton.

Figures 28, 29, 30, 31 and 40 are from the Division of Entomology of the U. S. Department of Agriculture, Washington, D. C., and used by permission of Dr. L. O. Howard, Chief of the Division.

Figures 37, 38 and 39 are from the Cornell Experiment Station bulletins by courtesy of Prof. M. V. Slingerland.

Figure 41 is from a drawing made by Dr. C. V. Riley and first published by LeBaron in the 5th Report on the Injurious Insects of Illinois, p. 99, and later in the *American Entomologist*, p. 202.

Figures 32, 33, 34, 35, 36 and 42 are reproduced from drawings by W. E. Britton.

THIRD REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

Under the laws of Connecticut the State Entomologist is required to make an annual report, and I herewith transmit my third Report. During the year the Insect Pest Law has been so amended that the authority and the duties of the State Entomologist have both been somewhat increased. In this, as in previous Reports, the insect work is recorded for the calendar year of 1903, but the financial statement covers the State fiscal year ending September 30, 1903.

Respectfully submitted,

W. E. BRITTON,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1902, TO SEPTEMBER 30TH, 1903.

RECEIPTS.

From E. H. Jenkins, Treasurer	$1,914.76
Adams Express Co., repairs on damaged pump	4.95
S. J. Griffin, for oil	1.44
Various sources for electrotypes	8.05
	$1,929.20

EXPENDITURES.

Field, office and laboratory assistance	$ 752.74	
Printing and illustrations	431.34	
Postage	3.27	
Stationery	1.80	
Telephone and telegraph	2.80	
Express, freight and cartage	40.09	
Library	155.63	
Laboratory apparatus and supplies	170.16	
Spraying apparatus and supplies	132.40	
Office supplies	7.60	
Traveling expenses	211.44	
	$1,909.27	
Balance; cash on hand	19.93	
		$1,929.20

Memorandum—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

THE CONNECTICUT LAW RELATING TO INSECT PESTS AND PLANT DISEASES.

AS AMENDED BY THE

GENERAL ASSEMBLY OF 1903.

The General Assembly of 1901 first enacted a law concerning insect pests which has been published in bulletin 134 of this Station and also in the first report of the State Entomologist (Report of this Station for 1901, Part III, p. 229).

The General Statutes of the State were revised by a committee on revision during the years 1901-1903 and the insect pest law as revised by this committee and adopted by the General Assembly at the beginning of the session of 1903 was printed in the second report of the State Entomologist (Report of this Station for 1902, Part II, p. 100). Later, during the session of 1903, two amendments were passed. These amendments to Sections 4387 and 4388 are herein printed in full-faced type.

THE INSECT PEST LAW.

Chapter 238, General Statutes of Connecticut.

Section 4386. State entomologist; appointment. Said board of control shall appoint a state entomologist to hold office during the pleasure of the board, who shall have an office at the experiment station, but shall receive no compensation other than his regular salary as a member of the station staff. He may appoint such number of deputies, not exceeding three, as he may deem necessary.

Sec. 4387. Duties. The state entomologist, either personally or through his deputies, shall visit any orchard, field, garden, nursery, or storehouse, on request of the owner, to advise treatment against pests. He may inspect any orchard, field, or garden, in public or private grounds, which he may know or have reason to suspect to be infested with San José scale or any serious pests **or infectious diseases, when in his judgment such pests or infectious diseases are a menace to adjoining owners; and may order the owner, occupant, or person in charge thereof, in writing, to properly spray or give other suitable**

treatment, or to cut and destroy any such diseased trees or shrubs, if in the opinion of the state entomologist such action is necessary, and the owner thereof shall not recover from nor be recompensed therefor by the state. If the owner of such orchard, field, or garden neglects or refuses to comply with the order of the said state entomologist, he shall be fined not more than fifty dollars. The state entomologist may issue such bulletins of said experiment station as in his judgment are needed to convey information about pests; may conduct experiments and investigations regarding injurious insects and the remedies for their attacks; diffuse such information by means of correspondence, lectures, and published matter; and may employ such assistants in his office, laboratory, or in the field, and purchase such apparatus and supplies as may be necessary. He shall keep a detailed account of expenses, and publish each year a report of such expenses, and of the work done.

Sec. 4388. Certificate of inspection of nursery stock. All nursery stock shipped into this state from any other state, county, or province, shall bear on each package a certificate that the contents of said package have been inspected by a state or government officer and that said contents **have been thoroughly fumigated and** appear free from all dangerous insects or disease. In case nursery stock is brought within the state without such a certificate, the consignee may return it to the consignor at the latter's expense, or may call the state entomologist to inspect the same and deduct the costs of such inspection from the consignor's bill for such stock. This section shall be deemed to be a part of every contract made in this state for the sale of nursery stock to be shipped into this state.

Sec. 4389. Inspection of nurseries. Penalty. All nurseries or places where nursery stock is grown, sold, or offered for sale, shall be inspected at least once each year by the state entomologist or one of his deputies, and if no serious pests are found, a certificate to that effect may be given. If such pests are found, the owner shall take such measures to suppress the same as the state entomologist may prescribe. If such measures are not immediately taken by the owner of such nursery or place, such certificate shall be withheld, and every nurseryman who does not hold such a certificate, after the first annual

inspection, who shall sell or otherwise dispose of nursery stock, shall be fined not more than fifty dollars. The form of certificate and the season for inspecting nurseries may be determined by the state entomologist. The state entomologist or any of his deputies may at all times enter any public or private grounds in the performance of his duty.

Sec. 4390. Appropriation. The sum of three thousand dollars is appropriated to carry out the provisions of Sections 4386, 4387, 4388, and 4389, which sum is to be paid quarterly to the treasurer of said station, who shall hold the same subject to the order of the state entomologist.

These amendments give the state entomologist discretionary power to cause the destruction or proper treatment of infested trees and shrubs, and if the owner refuses or neglects to act after having been duly ordered in writing by the state entomologist, he is subject to a fine of not more than fifty dollars.

It is also necessary that nursery stock shipped into the state shall bear a statement that it has been thoroughly fumigated in addition to the certificate of inspection issued by a state or government officer.

These amendments became operative July 1st, 1903.

A copy of the law, printed in circular form, was sent to nursery men of Connecticut and to inspectors of all other States during the summer.

Organization, Equipment, Etc.

Assistance.—Throughout the year the State Entomologist has been assisted in office, field and laboratory by Mr. B. H. Walden, who has done most of the photographic work, and has aided in the preparation of a portion of this report. Mr. Austin Turner was employed for three months in late winter and early spring to assist in the spraying experiments. Mr. Henry L. Viereck, a well-known entomologist and specialist in the Hymenoptera, began work October 15th, rearranging the specimens in the collection and working up the undetermined material. These gentlemen have all performed their duties faithfully and acceptably.

Equipment.—The collection of insects has been increased considerably and is being transferred to Schmitt boxes, which are

safer than the old cases. The Schmitt boxes will then be placed in metal cases, thus rendering the specimens doubly safe. Several glass-covered exhibition cases have been purchased and also a number of Riker mounts.

A "Hardie wheel outfit" consisting of a small barrel and pump mounted on wheels was bought for spraying trees and plants in the garden, and found to be convenient and satisfactory.

Exhibits.—Injurious insects, prepared insecticides, insecticide materials, spray pumps, nozzles, etc., have been shown at the annual meeting of the Connecticut Pomological Society at Hartford in February, and at the fruit exhibit of the same Society at Berlin in September; a similar exhibit was made at the annual meeting of the Connecticut Board of Agriculture at Middletown in December.

Library.—The entomological library has been enriched during the year by completing sets of the *Entomological News, Insect Life* and the Reports of the Ontario Entomological Society. Purchases have also been made of the Proceedings of the Entomological Society of Washington, Theobald's Monograph of the Culicidæ of the World, Green's Coccidæ of Ceylon, Newstead's Coccidæ of the British Isles, Wytsman's Genera Insectorum, and many special reports and monographs of one volume each.

Correspondence.

This part of the work has increased considerably, 900 letters being written as against 679 in 1902. These are all on matters pertaining to work of the office, the identification of specimens and remedial treatment recommended forming a large portion.

The work of inspecting nurseries and orchards and conducting spraying experiments also makes correspondence necessary.

Lectures at Meetings.

The State Entomologist is occasionally called upon to give lectures at fruit grower's institutes, farmer's meetings, granges, etc. During the year of 1903 twelve such gatherings have been addressed upon subjects connected with insects. Four of the lectures were illustrated with lantern slides. The State Entomologist attended the meeting of Official Horticultural Inspectors at Washington, November 17th and 18th.

PUBLICATIONS.

The following publications have been issued from the entomological department during 1903:

POSTAL CARD BULLETIN (not numbered with the regular series) containing brief instructions regarding immediate work against the San José scale-insect and Elm leaf-beetle, was printed in an edition of 11,000 copies and mailed to residents of the state during February.

BULLETIN 142 (SPRAY CALENDAR) was prepared jointly by the entomologist and botanist, half of the expense being paid from the entomological fund. It was sent out in February. An edition of 12,000 copies was published and a few hundred only remain for distribution.

SECOND REPORT OF THE STATE ENTOMOLOGIST (PART II OF THE REPORT OF THE STATION) was printed in an edition of 12,000 copies and distributed in March. This report contains 80 pages, 19 figures and XV plates, and gives an account of all the insect work of the Station during the year of 1902.

BULLETIN 143, Two Common Scale-Insects of the Orchard (The Scurfy Bark-Louse. The Oyster-Shell Bark-Louse) containing 10 pages, 5 figures and II plates was distributed during May in an edition of 12,000 copies. This bulletin contained the chief facts connected with the life-histories of the insects, descriptions and illustrations that enable the orchardist to identify them, and recommendations for remedial treatment. It was sent out shortly before the proper time to spray against these scale-insects.

BULLETIN 144, Fighting the San José Scale-Insect in 1903, 26 pages, III plates, gives an account of the season's experiments in spraying to kill this pest. Twelve thousand copies were printed and distributed in November.

CIRCULARS containing the text of the amended Insect Pest law were printed and sent to nurserymen in Connecticut, and to officers having charge of nursery inspection work in other states. Instructions regarding the use of the certificate were also issued to the nurserymen.

With the exception of Bulletin 142, and the Second Report of the State Entomologist, the above-named publications are reproduced in this Report in slightly emended form.

Inspection of Nurseries.

The nurseries of the state were inspected by the State Entomologist and his assistant, Mr. Walden. The work was commenced about the middle of September and nearly finished by November 1st, six weeks being required to do this work, in addition to the other necessary work of the entomologist's office.

The number and date of each certificate granted, as well as the names of the nursery firms receiving them, are given below:

List of Nursery Firms Receiving Certificates in 1903.

Name of Firm.	Location.	Inspection Finished.	Certificate Number.
Allen, Chas I.	Terryville	Nov. 4	132
Atwater, C. W.	Collinsville	Sept. 21	107
Barnes Bros.	Yalesville	Oct. 23	126
Beers, S. Perry	Greenfield Hill	Nov. 12	134
Bishop, J. N.	Plainville	Oct. 23	125
Bowditch, J. H.	Pomfret Center	Oct. 29	128
Bridgeport Nursery	Bridgeport	Dec. 31	139
Burr & Co., C. R. (2)	Manchester	Oct. 2	112
Butler & Jewell Co., The	Cromwell	Oct. 13	118
Comstock & Lyon	Norwalk	Oct. 14	119
Conine, F. E.	Stratford	Sept. 26	110
Conn. Agricultural College	Storrs	Oct. 22	123
Conn. Valley Orchard Co.	Berlin	Oct. 30	129
Conway, W. B.	New Haven	Oct. 2	116
Dehn & Bertolf	Greenwich	Oct. 8	120
East Rock Park Nursery	New Haven	Sept. 18	106
Elizabeth Park Nursery	Hartford	Sept. 21	108
Elm City Nursery Co.	New Haven	Sept. 25	109
Gardner's Nurseries	Cromwell	Oct. 13	117
Gurney & Co., H. H.	New Canaan	Oct. 5	114
Hale, J. H.	So. Glastonbury	Oct. 20	121
Holcomb, Irving (2)	West Granby	Dec. 22	137
Hoyt's Sons Co., Stephen	New Canaan	Oct. 5	115
Hunt & Co., W. W.	Hartford	Oct. 28	127
Jackson, B. A.	So. Norwalk	Nov. 25	135
Keney Park Nursery (2)	Hartford	Nov. 3	131
Longden, C. E.	North Haven	Sept. 15	105
Norton, A. F.	New Britain	Oct. 23	124
Pierson, A. N.	Cromwell	Oct. 3	111
Platt Co., The Frank S.	New Haven	Dec. 30	138
Purinton, C. O.	Hartford	Dec. 2	136
Ryther, O. E.	Norwich	Oct. 26	133
Smith Co., The H. C.	New Haven	April 8	103
Veitch Co., The Robert	New Haven	Oct. 31	130
Vidbourne & Co., J.	Hartford	Oct. 15	122
Wallace, W. E.	Hartford	Oct. 3	113

It will be noticed that the nurserymen's list contains thirty-six names. Last year there were thirty-one names upon the list. Two of these firms have gone out of business and seven other names have been added. Three of these nurseries were

inspected last year, but their owners did not get them cleaned up in time to receive certificates during the year of 1902; hence the names did not appear on the list.

Of these thirty-six nurseries, three were inspected twice and given certificates, thirty-nine certificates being issued during the year. At least four of the other nurseries were inspected twice, making in all forty-three nursery inspections for the year.

The form of the regular certificate granted to nurserymen is the same as was used in 1902, a facsimile of which is here reproduced.

No. _____ *Inspection completed* _____ *190*

THE

Connecticut Agricultural Experiment Station.

OFFICE OF STATE ENTOMOLOGIST,
NEW HAVEN, CONN.

Certificate of Inspection.

THIS IS TO CERTIFY that the stock at the nursery and premises of _____ of _____ Conn., has been carefully examined in compliance with the provisions of Chapter 122 of the Acts of the General Assembly, January Session of 1901, and that it is apparently free from dangerously injurious insects and diseases.

This certificate is invalid after _____ 190

_____ *State Entomologist.*

In addition to the regular inspection of nurseries as prescribed by the laws of the state, the entomologist is occasionally called upon to inspect stock intended for shipment by some person who is not in the nursery business. For instance, one person wished to send choice plants from his garden to a friend outside of Connecticut: a man who acted merely as a distributing agent for a New York nursery, wished to return surplus stock to the nursery. In each case the transportation company refused to carry the goods unless accompanied by certificates of inspection. Two certificates, which I have called emergency

certificates, were issued during the season to accommodate occasional shippers of nursery stock.

The emergency certificate just mentioned was made to apply only to the stock in the bale, package or box to which it was affixed. In other respects it was similar in form to, though distinct from, the regular nurserymen's certificate.

A copy of the following notice was given with each regular certificate:—

NOTICE TO NURSERYMEN AND SHIPPERS,

Regarding the Use of the Certificate.

The original nursery certificate issued by the State Entomologist under Section 4389 of the General Statutes is to be kept in your possession, and is not to be attached to any package of nursery stock. It applies to the whole nursery which has been inspected and to such purchased stock as has been received from other nurseries under the certificate of a state or government officer. Any stock received from outside the state unaccompanied by such a certificate is not allowed to be sent out until it has been duly inspected.

An exact transcript of the certificate may be printed on labels or tags for shipping and attached to each package sent out of the state, especially in such states as require it. An additional statement, made by the owner, that the stock has been fumigated will be required in many states. The law does not require that the inspection certificate be attached to every package shipped to points within the State of Connecticut, but it should accompany each box or package when convenient as it serves to call attention to the provision of the law.

The number, date, and in fact each word of the certificate must be printed on the shipping tags. Any omission will be looked upon as an abuse of the certificate and may lead to its being revoked by the State Entomologist.

Emergency certificates, to be used by persons wishing to ship a few trees or shrubs and who are not engaged in a regular nursery business, will be issued after an inspection has been made upon request. Such certificates apply only to the contents of the packages upon which they are placed.

After the date of expiration, which is a part of each certificate, the document becomes invalid and should not be attached to any box, bale or package.

W. E. BRITTON,
State Entomologist.

Condition of Nurseries in 1903.

On the whole the nurseries were in about the same condition in 1903 as in 1902. In ten nurseries the San José scale was not found, while twenty-six were found to be infested—some only slightly, others seriously. A few nurserymen informed the writer that they knew that the scale was present on their grounds, but that they had been too busy to give the matter any attention. How anyone can ignore this insect and allow it to multiply unchecked, especially where the stock must be inspected by state authorities, and where it may mean a loss of several hundreds of dollars in the destruction of stock, is quite incomprehensible. Several Connecticut nurserymen have been careless in this respect and considerable stock had to be destroyed on account of the owner's neglect. It is a case of "live and learn," though it would be far cheaper to follow advice than to gain the knowledge by any such experience. Most of the nurserymen of the state are extremely anxious to have their stock as clean as possible, and go to considerable expense to keep it so.

Of the infested nurseries, seven were found in worse condition, and ten in better shape than last year, in regard to the degree of infestation.

Wherever infested stock has been found in nurseries it has been destroyed, and in case of the larger nurseries, the remaining stock of fruit trees and deciduous trees and shrubs that are subject to attack by the scale have been fumigated with hydrocyanic acid gas.

Nurseries have somewhat increased in acreage during the year and probably now have a total area of about 500 acres.

There is a decided tendency among the smaller nurserymen to keep on hand a larger stock of those trees and shrubs not attacked by the scale and to buy each year from the large nurseries, as needed, their fruit trees and other stock that is especially liable to infestation.

It seems to the writer that the use of varieties of plants which the scale does not attack should be encouraged as much as possible in landscape and ornamental planting. Landscape gardeners and nurserymen have an excellent opportunity to point out the desirable and undesirable features of plants in this respect.

Fumigation of Nursery Stock.

The desirability of fumigation laws has been discussed in nearly all the states of the Union and in many cases such laws have been enacted. Fumigation is not an infallible remedial treatment for the San José scale, as in several cases insects have come through it alive, but if properly conducted it is the surest method that we can at present recommend for destroying the scale and saving the trees. The expense is not great in the larger nurseries where a proper outfit is installed for the purpose. Eight of the larger nurseries are now provided with regular fumigating houses and several more are now being built. The entomologist and his assistants try to encourage this as much as possible and give advice and information regarding the proper method of construction and operation.

It is not improbable that a compulsory fumigation law may soon be passed in Connecticut. It should be considered carefully, however, and not prepared in haste. Many such laws provide for the fumigation of all nursery stock without explaining what is meant by the term "nursery stock." In the writer's opinion it is quite unnecessary to fumigate herbaceous plants and conifers. All fruit stock, and such other deciduous trees and shrubs as are attacked by the scale, should be fumigated. The law should either distinctly specify what kinds are to be fumigated or it should be left to the discretion of the officer in charge of the work.

Florists who ship living plants and especially such shrubby plants as azaleas, roses, etc., occasionally complain that their shipments have been refused by transportation companies or "held up" by inspection officers because not accompanied by a certificate. Now most of the laws concerning the subject expressly exclude greenhouse plants from the need of fumigation, and if florists would attach a tag or label reading, "Greenhouse plants" to every package shipped, this trouble would probably be avoided.

Examinations of Orchards, Gardens, Etc.

Twenty-five orchards, gardens, greenhouses, etc., have been examined during the year to see if insect pests were present.

Most of these examinations were made at the request of the owner, a few at the request of interested parties. The entomologist has also made several examinations on his own account.

Scale-Infested Localities.

Fifty-six infested localities have been discovered during the year, making in all two hundred and twenty-one, including nurseries. The San José scale is now known to exist in every county in Connecticut, and it will probably be only a short time when there will be no region that is not infested.

Mosquito Investigations.

On account of a pressure of other work, very little time could be devoted to mosquito investigations. Nevertheless, some collecting and breeding was done, and a portion of the region about New Haven was explored for the natural breeding places of mosquitoes. We have already taken thirteen species in the state. This important work will be continued and a careful survey made of the principal breeding places. The State Entomologist will be glad to hear from any localities where an organized effort is being made to prevent the breeding of mosquitoes, and will, if possible, institute an investigation of the local conditions and give advice as to the best method of treatment.

Study of Tobacco Insects.

It was planned to make a somewhat extensive study of the insects attacking the tobacco plant in Connecticut during the season and many visits were made to the fields during the summer. Very few insects were collected, however, and tobacco growers assert that the crop of 1903 has been unusually free from insect attack. It will be necessary, therefore, to continue the observations for one or more seasons before we can hope to publish anything about Connecticut tobacco insects.

GENERAL INSECT REVIEW.

Meteorological conditions.—The weather conditions of 1903 were somewhat unusual and it is customary to ascribe the extraordinary prevalence or absence of insects to the effect of the weather either upon the noxious species or upon their parasites. During the early part of December, 1903, the temperature was high and the ground bare and not frozen. About the eighth, there was a light fall of snow with a sudden drop in the temperature. The minimum temperature of the winter was recorded on the

morning of the ninth when the mercury went far below zero, varying of course in different localities. The effect was very disastrous to many fruit trees in which the sap had been moving only a few days before. Blossom buds were killed generally in the Connecticut peach orchards, and in some nurseries peach and even apple trees were greatly injured, as shown by a curious discoloration of the wood and failure to make a satisfactory growth afterwards. Though there were other spells of cold weather during the winter, to this December freeze can be attributed most of the injury to trees.

There was considerable speculation regarding the effect of this sudden freeze upon insect life and especially upon the San José scale. In making a careful examination of thousands of these insects, in connection with our spraying experiments to kill them, from one hundred and twenty trees in four different localities of the state, the average mortality of San José scale-insects was found to be 27.6 per cent. Our record of the previous year from three localities shows a mortality of 35.6 per cent. from thirty-seven trees, while in 1901, from twenty-two trees in three localities, we obtained a mortality record of 14 per cent. The normal effect of the winter kills probably not far from 25 per cent. of the scales. The winter of 1902-1903 was not then an abnormally disastrous one so far as killing the San José scale is concerned. Further proof is found in the rapidity with which this insect multiplied during the summer.

The chief characteristic of the summer of 1903 was the severe drought during the latter part of April and extending through the month of May, at a time when all kinds of vegetation should be making the most rapid growth. While there was no lack of moisture during the remaining months of the summer, the season was characterized by its coolness, there being few hot days.

Abundance of Plant-lice.—The dry weather of spring seemed to be favorable to the rapid multiplication of many kinds of plant-lice, which were generally very abundant. The apple-leaf aphis, which is described in another part of this Report, proved a serious pest. Cherry, plum and currant lice were present on their respective host-plants, and shade-trees in many places were fairly dripping with the sweet "honey dew" exuded by the plant-lice that were sucking sap from their leaves. Even the weeds of the garden and roadside, as well as the ornamental

and useful cultivated plants, were the subjects of similar attack. Later in summer, when rains were frequent, a fungus, or "sooty mold" grew in the "honey dew," giving a black and scorched appearance to trees and plants.

The green pea louse (*Nectarophora pisi* Kalt.) was less abundant than during the previous season. It has been on the decrease since 1900, and while late peas may be injured in some cases, in others it has not been found necessary to apply any remedial treatment. The pear psylla (*Psylla pyricola*) was a scourge to most of the pear trees of this vicinity, and as specimens were received from different parts of the state it was probably not less severe elsewhere. A separate account of this insect is given on another page of this Report.

Scale-Insects.—Reports from fruit growers in various parts of the state show that the San José scale-insect has multiplied very rapidly in infested orchards. The same may perhaps be said of some other kinds of scale-insects. The apricot scale (*Eulecanium armeniacum* Craw.) is becoming quite common in Connecticut, and has been found on grape, rose, chestnut; and white ash trees in the woodlands of Windsor were quite badly infested. This species has also been received from West Cornwall on white ash. It is known to attack all kinds of fruit trees.

Tent-caterpillar and Fall Web-worm.—These insects were perhaps less abundant than in 1902, yet they did much injury to fruit and shade trees. The eggs of the tent-caterpillar hatched very early and in some localities the nests were much in evidence. Mr. J. M. Whittlesey of Morris writes that in his vicinity nests were more abundant than he has ever seen them before, but that nearly all of the caterpillars died before reaching maturity.

The cause of their death was not learned but was doubtless one of the parasites or natural enemies of the tent-caterpillar—possibly the bacterial disease.

During August and September the nests of the fall web-worm were a part of nearly every landscape view though less abundant than in 1901 and 1902.

Scarcity of Potato Beetles.—The Colorado potato beetle was less abundant than for many years, and in some potato fields poisoning was unnecessary. The writer cannot remember a year, since the beetle came into New England, when potato fields

have suffered so little injury as during the past season. Not only was this true of Connecticut, but in southern New Hampshire, where the writer stayed during August, the reports were similar.

Elm Leaf-Beetle also less abundant.—Much less damage was done to the elm trees of New Haven and near-by cities and towns than for several years.

Hickory Bark-Borer.—This destructive insect seems also to be on the wane in New Haven. Some trees had to be removed from the attacks of last year, but evidently much less damage was done to new trees than for two years. (See Reports for 1901, p. 267, and for 1902, p. 169.)

The tobacco crop throughout the state was almost free from insect attack, the tobacco worm being very scarce.

It is difficult to account for the decreased activity of the insects just mentioned. Possibly the winter, possibly predaceous and parasitic enemies may be responsible for it. It is well known, however, that most native species of insects fluctuate considerably in abundance, and when numerous for one or more seasons, a period of decrease follows.

Other Insects.—Mention was made in my last Report (Report for 1902, page 174) of the presence in Connecticut of the twelve-spotted asparagus beetle (*Crioceris 12-punctata* Linn.). Several more specimens were this year taken at New Haven, and we may from now on regard this as one of the injurious species of the state.

The onion thrips (*Thrips tabaci* Linde.) destroyed a three acre field of onions near New Haven in July. The writer saw the field on July 24th and advised treatment, but the injury had then been done and the owner decided to plow the field and put in some other crop. A short account of this insect is given on another page of this Report.

Lady Beetles were abundant all through the season, and the plant lice upon which they prey certainly gave them food in abundance.

Two New Beneficial Insects.—On February 1, 1902, a curious object was received from a nursery in Westville, near New Haven, found upon *Ilex crenata,* which had been imported from Japan the previous spring. This proved to be the egg-case of an orthopterous insect of Asia, *Paratenodera sinensis* Saus.

Paratenodera belongs to the *Mantidæ*, and feeds upon other insects, especially plant lice, grasshoppers and caterpillars. During the summer of 1903 another of these egg-cases was found in the same nursery, indicating that the insect had already partially established itself in Connecticut. As the same insect has become thoroughly established in a similar way near Philadelphia, it is quite probable that the egg-masses were imported directly from Japan with the shrubs. A number of these egg-cases have just been procured from Philadelphia, through the kindness of a friend, and these will be placed out of doors at the proper time and the results watched with interest.

Another insect that is likely to prove beneficial is the European Praying Mantis, *Mantis religiosa* Linn., which was accidentally introduced into the state of New York a few years ago. An account of this insect was given by Professor M. V. Slingerland in Bulletin 185, of the Cornell Experiment Station. The European Praying Mantis feeds upon living insects, including grasshoppers, flies, etc. Several egg-masses have been procured from Central New York and these will also be placed outside where we can watch them. Both *Mantis religiosa* and *Paratenodera sinensis* have a striking appearance and if they become established in Connecticut we will have more to say about them later.

Chinese Lady-Beetle.—Though application for some of these beetles was made over two years ago, we have not yet been able to obtain any specimens for Connecticut. Beetles have been furnished, however, to some of the other states, and it is hoped that they may increase sufficiently, so that a few may be spared for Connecticut during the coming season.

Periodical Cicada not observed.—A brood of the periodical cicada or seventeen-year locust was expected to appear in Connecticut during 1903, but though we were on the lookout, were not able to find specimens or any indications that the brood appeared. Several correspondents were notified to be on the watch and to report as soon as the species was observed. So far as this office is concerned, we have no records of this brood, though it is reported from Rhode Island.

The more important injurious insects of the season mentioned in the foregoing pages are treated more fully elsewhere in the following pages of this Report.

Identification of Insects.

A good deal of time is required for naming the insect specimens sent by correspondents. If the specimen is a common species very little trouble or time is necessary to identify it. But not infrequently a half-day or one or more entire days are spent in determining a single specimen, and then it is sometimes necessary to send it to a specialist in the particular group or family to which it belongs in order to make sure of its identity. Nevertheless, the work is of such importance that it cannot be dropped or neglected, for it is a guide to the prevalence of species during the season and it is of direct service to the farmers and plant growers of the state.

During the calendar year, 185 samples of insects and other forms of animal life have been received for identification.

For the identification of species unknown to the writer he is indebted to the following entomologists who have kindly examined material from the collection:—Dr. L. O. Howard, Washington, D. C.; Mr. Geo. B. King, Lawrence, Mass.; Mr. E. P. Van Duzee, Buffalo, N. Y.; Mr. C. W. Johnson, Boston, Mass., and Mr. Henry L. Viereck.

Following is a list of such specimens so far as they can be determined:—

Insects and Other Animals Received for Identification.

Date.	Name.	Host.	Locality.	Remarks.
Jan. 26	Tulip Tree Scale, *Eulecanium tulipiferæ* Cook	*Liriodendron*	New Haven	On young street tree in northern part of city.
" 28	San José Scale, *Aspidiotus perniciosus* Comst.	Elm	Hartford	Badly infested.
Feb. 3	Tulip Tree Scale, *Eulecanium tulipiferæ* Cook	*Liriodendron*	Middletown	Lower branches of tree infested.
" 11	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Glastonbury	Egg stage.
" 16	" " " "	Pear	Cannon Station	"
" 19	Brown Aphis of violet, *Rhophalosiphum violæ* Pergande	Violet	New Haven	All dead: had been fumigated with hydrocyanic acid gas.
	Red Spider, *Tetranychus telarius* L.	"	"	These were subjected to same treatment as preceding, but were not all killed.
" 20	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Milford	Had been sprayed with kerosene.
	" " " "	Peach		No address accompanied the specimens.
" 21	White-fly, *Aleyrodes vaporariorum* Westw.	Tomato	Pomfret	Sent by request.
" 26	San José Scale, *Aspidiotus perniciosus* Comst.	Pear, Apple	Greens Farms	Twigs well covered.
Mar. 10	" " " "	Pear, Currant	Southington	" " "
	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Apple	"	Moderately infested.
	Green Apple Aphis, *Aphis pomi* DeG.	"	North Grosvenordale	Egg stage. A few eggs glued around the buds.
" 12	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	Bridgeport	Egg stage.
" 16	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Currant	New Haven	"
	San José Scale, *Aspidiotus perniciosus* Comst.	Quince	"	Branch thoroughly encrusted.
" 17	" " "	Apple, Plum, Currant	Bridgeport	" " "
" 25	" " "	Pear	Shelton	" " "
	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Currant	Hockanum	Egg stage.
" 27	San José Scale, *Aspidiotus perniciosus* Comst.		Meriden	
" 28	" " "	Apple, Pear, Plum	New Haven	Badly infested.
	Green Apple Aphis, *Aphis pomi* DeG.	Apple	Orange	Black eggs around the buds.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
Mar. 31	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	Meriden	Empty shells.
	San José Scale, *Aspidiotus perniciosus* Comst.	Apple, Peach, Plum	"	Twigs badly infested.
April 6	" " "	Currant	Bridgeport	" " "
" 7	Apple-Tree Tent-Caterpillar, *Clisiocampa americana* Harris	Lilac	Hartford	Young larvæ hatched April 5th.
	Microgaster fly ———	Pandorus or achemon caterpillar	"	Cocoons of hymenopterous parasite.
" 8	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	East Norwalk	Dead twig thoroughly covered.
" 14	" " "	Apple, Pear	Seymour	Sections of bark well infested.
" 17	" " "	Plum	Hawleyville	Twigs badly infested.
" 18	" " "	Apple	Southington	A few specimens on twig.
	Woolly Aphis, *Schizoneura lanigera* Hausm.	"	"	Aphids clustered in open wounds of bark.
" 22	Spotted Lady Beetle, *Megilla maculata* DeG.		Norwalk	Found resting at base of tree.
	Squash Beetle, *Epilachna borealis* Fabr.		"	" " " "
	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	New Haven	Twigs badly infested.
	Rose Scale, *Aulacaspis rosæ* Bouché	Rose	Plantsville	A few specimens on same canes as following.
	Hymenopterous galls ———	"	"	Galls of a hymenopterous insect at base of lateral branches.
" 23	San José Scale, *Aspidiotus perniciosus* Comst.	Pear	Meriden	A few specimens on twigs.
	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	"	"	Egg stage. On same twigs as preceding.
" 24	Green Apple Aphis, *Aphis pomi* DeG.	Apple	North Haven	Eggs and shells on twigs around buds.
" 27	Peach Borer, *Sanninoidea exitiosa* Say.	Peach	Chapinville	Larvæ from base of trees.
	Fungus gnats ———?	"	"	Mycetophilous larvæ in gregarious masses in gum at base of trees.
" 27	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Black Walnut	New Britain	Dead branch covered with dead scales.
May 1	Katydid eggs ———?	Cedar	New Haven	Eggs laid on twigs.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
May 9	Myriapod, *Spirobolus marginatus* Say.	Black Walnut	Middletown	Found in dead roots and soil.
"	Oak Scale, *Asterolecanium variolosum* Ratz.	Oak	Hartford	On scarlet oak in city park.
" 13	Clothes Moth, *Tinea sp.?*	Clothing	New Haven	Adults from closet.
" 14	Virgin Moth, *Spilosoma virginica* Fabr.		Hamden	Adult.
	Woolly Aphis, probably *Phyllaphis fagi* L.	Purple Beech	New Haven	A few specimens on leaf.
" 15	Orthezia, *Orthezia insignis* Dougl.	Lantana	"	On plants in greenhouse.
" 19	Elm Leaf-Beetle, *Galerucella luteola* Müll.	House	So. Canterbury	Found on window in attic.
	Aphis ——?—	Plum	"	Aphis on leaves. Had been sprayed with kerosene emulsion.
" 25	Tulip Tree Scale, *Eulecanium tulipiferæ* Cook	*Liriodendron*	Hamden	Partially grown males on twig.
	Luna Moth, *Actias luna* L.		Farmington	Female. Laid a mass of eggs.
	Strawberry Saw-fly, *Harpiphorus maculatus* Norton	Strawberry	Cromwell	Larvæ feeding on Strawberry leaves.
" 28	——*Acanthia hirundinis* Jenyns.	House	Mt. Carmel	Found about chimney over fireplace.
	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Ash	West Cornwall	Branch well covered. Eggs have hatched and young are crawling.
	Apricot Scale, *Eulecanium armeniacum* Craw.	"	"	Branch well infested. Egg stage.
	Hickory Stem Gall-Louse, *Phylloxera caryæcaulis* Fitch	Hickory	Stockbridge, Mass.	Forming galls on leaf-stems and blossoms. Females and eggs inside the galls.
	——	Linden	New Haven	Galls on upper surface of leaf. No insects could be found.
June 1	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	Hartford	Eggs had hatched and young had established themselves.
" 2	Elm Scale, *Gossyparia spuria* Mod. (*ulmi*)	Elm	Southington	A few specimens on twigs.
	Elm Leaf-Beetle, *Galerucella luteola* Müll.	"	"	Bunch of eggs on leaf.
	——	"	Middletown	
	Aphis ——	Maple	"	On leaves.
" 3	Eyed Elater, *Alaus oculatus* Linn.		Forestville	
	Woolly Aphis, probably *Phyllaphis fagi* L.	Beech	Stratford	Leaves well infested.
	Aphis	Cut-leaved Birch	"	Leaves infested.

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
June 3	Aphis	Lima Beans	Shelton	A few specimens on leaf.
" 4	"	Norway Maple	New Canaan	On under side of leaves which were covered with honey dew.
" 5	Woolly Aphis, *Pemphigus tessellata* Fitch	Alder	Southbury	On leaves and twigs.
	Alder Mite, *Phytoptus* ——?	"	"	Forming galls on upper surface of leaf.
	Hackberry Leaf Gall-Louse, *Pachypsylla celtidis-mamma* Riley	Hackberry	New Haven	Forming galls on under surface of leaves.
	Spiny Elm Caterpillar, *Vanessa antiopa* L.	Elm	Middlebury	Devouring leaves of the elm tree.
" 8	Hickory Stem Gall-Louse, *Phylloxera caryæcaulis* Fitch	Hickory	New Preston	Galls on leaf-stems filled with young lice.
	Apricot Scale, *Eulecanium armeniacum* Craw.	Chestnut	Waterville	Egg stage: brown hemispherical scale-insect on bark of twigs.
" 10	" " "	Rose	Windsorville	Egg stage: twig covered.
	Promethea Moth, *Attacus promethea* Dru.		New Haven	Female adult.
" 12	Glow Worm, *Phengodes laticollis* Lec. ?		Mt. Carmel	Apparently an adult female resembling a larva. Luminous and very handsome.
" 14	——		New Haven	Larvæ found in park.
	Rose Scale, *Aulacaspis rosæ* Bouché	Rose	"	A few specimens on bark of twig.
	Dragon-fly, *Epiæschna heros* Fabr.		"	
" 15	Apricot Scale, *Eulecanium armeniacum* Craw.	Rose	Windsorville	More material sent at my request.
" 18	Green Apple Aphis, *Aphis pomi* DeG.	Apple	Mt. Carmel	On under surface of leaves.
	" " —— ?	*Lonicera sempervirens*	"	On leaves.
" 20	Tortoise Beetle, *Coptocycla clavata* Fabr.	Potato	Cheshire	Devouring leaves.
	Four-lined Leaf-Bug, *Pœcilocapsus lineatus* Fabr.	"	"	Sucking sap from the leaves.
	Striped Squash Beetle, *Diabrotica vittata* Fabr.	Potato, Squash	Cheshire	Devouring leaves.
" 23	Woolly Elm Aphis, *Schizoneura americana* Riley	Elm	Norwich	On under surface, causing leaves to roll, forming pseudo-galls.
	Black Long Sting, *Thalessa atrata* Fabr.		New Haven	Female with long ovipostor.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
June 25	Cherry Aphis, *Myzus cerasi* Fabr.	Cherry	Guilford	Leaves curled. Black aphis.
	Currant Fruit Worm	Currant	East Norwalk	Infesting berries of Fay's Prolific variety.
" 27	Green Apple Aphis, *Aphis pomi* DeG.?	Apple	Glastonbury	Too badly crushed for specific identification.
	Currant Aphis, *Myzus ribis* L.?	Currant	"	
	Cherry Aphis, *Myzus cerasi* Fabr.?	Cherry	"	
	Green Apple Aphis, *Aphis pomi* DeG.?	Apple	Cannon Station	
" 30	" " "	"	Windsor Locks	Young twigs covered with green lice.
	—— *Hamamelistes spinosus* Shimer	White Birch	New Haven	On birch leaves, killing them.
July 1	Rudbeckia Aphis, *Nectarophora rudbeckiæ* Fitch	*Rudbeckia* Golden Glow	"	Red aphis on stalks.
	Strawberry Leaf-Roller, *Ancylis comptana* Frœl.	Dewberry	Highwood	Quite abundant in field of Lucretia dewberries.
	Fruit Bark Beetle, *Scolytus rugulosus* Ratz.	Japan Plum	Hamden	Seriously injuring trees.
" 3	Currant Fruit Worm, ——	Currant	Norwalk	Infesting berries.
" 7	Aphis, *Nectorophora sp.?*	Potato	Fairfield	Very abundant on leaves and stems.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Hartford	Causing leaves to fall. Honey dew and insects abundant.
" 9	Unicorn Caterpillar, *Schizura unicornis* S. & A.	Apple	Shelton	Partially grown larva devouring leaves.
	Maple Aphis, *Chaitophorus sp.?*	Norway Maple	East Norwalk	Infesting leaves. Honey dew abundant.
" 10	Aphis ——	Hop	Westville	Black lice on leaves.
	Lady Beetle, ——?	"	"	Larvæ feeding upon the plant lice.
	Glow Worm, *Phengodes sp.?*		Waterbury	Appears to be a larva. 1 inch long. Found in grass under maple trees.
" 14	Twice-stabbed Lady Beetle, *Chilocorus bivulnerus* Müls.	Apple	Bloomfield	Pupæ and larval skins present.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Portland	Fruit and leaves badly infested.
" 15	Work of Flea-Beetle, ——?	Potato	Bristol	Leaves perforated.
" 16	Pear Psylla, *Psylla pyricola* Först.	Pear	Seymour	Leaves badly infested and falling.
	Apricot Scale, *Eulecanium armeniacum* Craw.	Japan Plum	"	Twig covered by old shells. Young crawling.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
July 17	Green Apple Aphis, *Aphis pomi* DeG.	Apple	West Haven	Specimen crushed.
" 18	Maple Borer, *Plagionotus speciosus* Say.	Maple	New Haven	Adult and larvæ of different sizes.
	——— *Alaria florida* Gn.		"	Found in building.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Hamden	On twigs of new growth causing leaves to curl.
" 20	Senator Moth, *Anisota senatoria* S. & A.		New Haven	Adult found in raspberry patch.
" 23	Apple-Tree Tent-Caterpillar, *Clisiocampa americana* Harris	Peach	Lyme	Egg-mass on twig.
" 29	Long-horned Beetle, *Romaleum atromarium* Dru.		New Haven	Adult crawling under oak tree.
" 31	Green Apple Aphis, *Aphis pomi* DeG.	Apple	Cheshire	On under surface of leaves.
	Lesser Prionus, *Orthosoma brunneum* Först.		New Haven	Crawling in dwelling house.
	——— *Chrysochus auratus* Fabr.		West Haven	Single adult specimen.
	Mexican Jumping Seeds, ———?	*Euphorbia*	Mexico	Larva inside of each locule.
Aug. 1	Lesser Prionus, *Orthosoma brunneum* Först.		New Haven	
" 4	Pear Psylla, *Psylla pyricola* Först.	Pear	West Granby	On leaves and twigs.
" 6	" " "	"	Woodbury	" "
" 8	Celery Butterfly, *Papilio polyxenes* (*asterias*) Fabr.		New Haven	Male and female adults.
" 12	Chain-dotted Geometer, *Cingilia catenaria* Dru.	Sweet Fern	Terryville	Yellow and black larvæ feeding on various low growing shrubs.
" 14	Peach Borer, *Sanninoidea exitiosa* Say.	Peach	Hartford	
	Robber Fly, *Erax bastardi* Macq.		"	
" 17	Saddle-back Caterpillar, *Sibine stimulea* Clem.	Corn	Hamden	
" 22	Assassin Bug, *Acholla multispinosa* DeG.	Apple	Warehouse Point	Found crawling on trees.
" 24	San José Scale, *Aspidiotus perniciosus* Comst.	Plum	Rockville	Badly infested.
" 25	Saddle-back Caterpillar *Sibine stimulea* Clem.		New Haven	
" 28	Dog-day Harvest-fly, *Cicada tibicen* Linn.		Windsor	Found in cellar of dwelling.
" 29	Fruit Bark-Beetle, *Scolytus rugulosus* Ratz.	Plum	Cheshire	
	Hymenopterous insects ———		"	Evidently parasites upon preceding.
" 31	———	Hickory	New Haven	Larva found in twigs where adult *Scolytus quadrispinosus* occurred.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
Sept. 5	Pine Aphis, *Lachnus strobi* Fitch	Pine	Springdale	Twigs and leaves covered with sooty fungus growing in the honey dew.
	White Scale, *Chionaspis americana* Johns	Elm	Hartford	Supposed to have killed the branches.
" 8	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Higganum	Both sexes present.
	Green Apple Aphis, *Aphis pomi* DeG.	"	"	Cast skins and parasitized aphids on under surface of leaf.
	San José Scale, *Aspidiotus perniciosus* Comst.	Japan Plum	"	A few specimens on twigs.
	Work of Fruit Bark Beetle, *Scolytus rugulosus* Ratz.	"	"	Small holes in bark of twigs.
	Checkered Tussock Caterpillar, *Halisidota tessellaris* S. & A.		New Haven	Larva crawling about buildings.
" 10	Spruce Bud-Louse, *Chermaphis abietis* L.?	Spruce	"	Empty galls made in spring.
" 14	San José Scale, *Aspidiotus perniciosus* Comst.	Currant, Apple	Portland	Twigs well infested. Young crawling.
	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	"	Mostly males present.
	Locust Borer, *Cyllene robiniæ* Först.	Locust	New Haven	Male and female collected on locust tree.
	Brown Beetle, *Xyleborus celsus* Eich.	Hickory	"	Boring in wood of trunk.
" 21	Plant Louse, *Lachnus sp.?*	Pin Oak	Hartford	Very large species crawling on bark of dead branches.
" 24	Aphis on Maple, *Callipterus sp.?*	Norway Maple	Chestnut Hill	A few specimens on leaves. Sooty fungus abundant in honey dew.
	Pear Psylla, *Psylla pyricola* Först.	Pear	"	Sooty fungus and cast skins present.
Oct. 3	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	Stamford	Badly infested twigs.
	Spruce Bud-Louse, *Chermaphis abietis* L.?	Norway Spruce	"	Empty galls on new growth.
" 6	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Westerly, R. I.	Thoroughly infested.
	House Centipede, *Scutigera forceps* Raf.		Hartford	A myriapod found in cellar.
" 8	Pear Psylla, *Psylla pyricola* Först.	Pear	South Windsor	Abundant on leaves and twigs.
	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	"	"	A few specimens on twigs.
	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	"	" "
" 10	Chain-dotted Geometer, *Cingilia catenaria* Dru.		Bloomfield	Single adult specimen.
	Soldier Beetle, *Telephorus carolinus* Fabr.		"	Adult somewhat crushed.
	Assassin Bug.		"	Too badly crushed for recognition.
	"		"	

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
Oct. 16	Northern Mole-Cricket, *Gryllotalpa borealis* Burm.		Bloomfield	First specimen in Station collection. Said to be rare in Connecticut.
" 19	Pine Scale, *Chionaspis pinifoliæ* Fitch	White Pine	Hartford	Leaves covered with scales.
" 21	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Greenwich	Badly infested.
	White-Fly, *Aleyrodes vaporariorum* Westw.	*Eupatorium*	Terryville	Under surface of leaves covered with adults and larvæ.
Nov. 17	Hemipterous eggs ——?	Apple	Warehouse Point	Eggs in clusters on twigs.
" 28	San José Scale, *Aspidiotus perniciosus* Comst.	"	Meriden	Young still crawling, though the weather had been cold for several days.
Dec. 1	" " "	Japan Plum	Wethersfield	Badly infested.
" 9	" " "	Currant	New Haven	A number of specimens on short twig. A few had just set.
	Cherry Scale, *Aspidiotus forbesi* Johns	Cherry	"	One mature female present.
	—— *Aspidiotus ulmi* Johns?	Elm	"	Many dead scales on inner bark under edges of thick bark.
	White Scale, *Chionaspis americana* Johns	"	"	Only the eggs were present.
" 16	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Plantsville	Sent for examination as to mortality.
" 19	" " "	Pear	New Haven	A few scattered specimens on small twigs.
	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché.	Butternut	Yantic	Bark thoroughly covered with old shells.
" 24	—— Scale, *Eulecanium cerasifex* Fitch	Japan Plum	Berlin	
" 28	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	"	Branch moderately infested.
	" " "	Cherry, Pear	Plantsville	A few dead scales around buds. Had been treated.
" 30	" " "	Apple, Pear	Hartford	A few scales around buds: some alive and some dead.
	Mite, probably *Bryobia pratensis* Garman	Apple	"	Red spherical eggs clustered around the buds.
	Ground Snake, *Carphophiops amœnus* Say		Lenox, Mass.	Immature specimen between four and five inches in length.

Sending Insects by Mail.

Recently, the statement has been made in the public press that, on account of the great liability of distributing dangerous pests, all insects would be excluded from the mails. This statement was made once, at least, in connection with an account of the cotton boll worm, which is causing such losses to the cotton growing industry of the southern states.

The following article by Dr. L. O. Howard of Washington, D. C., was published in *Entomological News* for January, 1904, and is self-explanatory. It is here reproduced by permission of the editor, Dr. Henry Skinner.

"While there has been a very general exchange of cabinet specimens of insects by means of the United States mails, and while people have sent to the state entomologists and to the government entomologists living specimens with supplies of food, Section 494 of the Postal Laws and Regulations (page 226) specifically excludes insects from the mails. The enforcement of this regulation by a southern postmaster recently caused Mr. Wilmon Newell, State Entomologist of Georgia, to urge me to inform him accurately as to the attitude of the Post Office Department on this subject. I therefore prepared for the signature of the Honorable, the Secretary of Agriculture, a letter addressed to the Postmaster General asking for a modification of this section on the ground that its enforcement would hamper the work of the Department of Agriculture and would cause serious inconvenience to entomologists all through the country. The Postmaster General replied promptly and wisely, and courteously agreed to the suggestion of Secretary Wilson and urged that a representative of the Department of Agriculture be appointed to discuss any proposed amendment with the Superintendent of the Railway Mail Service. I was designated to act for the Secretary of Agriculture, and after consultation with Mr. Alexander Grant, Assistant General Superintendent of the Railway Mail Service, the following order was prepared and was issued by the Postmaster General:

Office of the Postmaster General,
Washington, D. C., Feb. 16, 1903.

Order No. 1269a.

Modify the Postal Laws and Regulations, edition of 1902, as follows: Section 494, paragraph 1, line 3: Omit the word "insects."

Section 496: Omit paragraph 7 and insert in lieu thereof the following:

7. Queen bees and their attendant bees, the "Australian lady bird," insects (live or dried), and dried reptiles may be sent in the mails when so put up as to render it practically impossible that the package shall be broken in transit, the persons of those handling the mails injured, or the mail bags or their contents soiled. (See paragraph 1 of this Section.)

H. C. PAYNE,
Postmaster General.

Knowing that this order will be of wide interest to entomologists, I trust that this communication will be published in *Entomological News.*"

This ruling of the postal authorities makes it possible to send insects by mail when properly packed, and I take this opportunity to say a word to correspondents on this point. Specimens should never be placed, loose, in an envelope. Even if they do not escape, or soil the contents of the mail bag, they are usually crushed beyond all recognition when received. Insects should be enclosed in a strong pasteboard, tin, or wooden box so that they cannot be crushed. Where possible, it is well to include a portion of the food plant, but it is never necessary to punch holes in the box to admit air. Insects can usually obtain plenty of air, even in a closed box.

TWO COMMON SCALE-INSECTS OF THE ORCHARD.*

The Scurfy Bark-Louse *Chionaspis furfurus* Fitch.

The Oyster-Shell Bark-Louse *Mytilaspis pomorum* Bouché.

Long before Connecticut orchards were attacked by the San José or pernicious scale-insect, the scurfy bark-louse and the oyster-shell bark-louse were present as parasites upon the trees and caused considerable damage each year. These orchard enemies still injure trees, though their work has been somewhat overshadowed by the damage of the San José scale during the last few years. The two kinds of scale-insects

* This paper was published as Bulletin 143 in May, 1903, in an edition of 12,000 copies. It is here reproduced with slight changes.

described in this publication are frequently received at the Station and the correspondent usually asks if it is the San José scale. This bulletin has been prepared for the purpose of distributing information about these two common species and the remedies for them, as well as to point out wherein they differ

FIG. 27.—San José scale on peach twig: a. mature female: b. young females: c. immature males. About twice natural size.

in appearance from the San José scale. The San José scale-insect has three or four broods each year, is circular in outline, and is shown in figure 27. The oyster-shell and scurfy bark-lice are much larger, elongated or pear-shaped, and single brooded. See figures 28 and 30.

The life histories of the species forming the subject of this bulletin are so nearly alike that the same remedial treatment answers for both.

The terms "scale" and "bark-louse" are both applied to insects of this group (*Coccidæ*) and may be considered as synonymous with the compound word "scale-insect."

The Scurfy Bark-Louse.

The scurfy bark-louse is a native of North America, and was formerly called "Harris' Bark-Louse." It is now found throughout the United States, and, according to Howard, is being succeeded by the oyster-shell bark-louse.*

The female scale is about 3 mm. (⅛ inch) in length, broadly pear-shaped, with the cast larval skin at the smaller

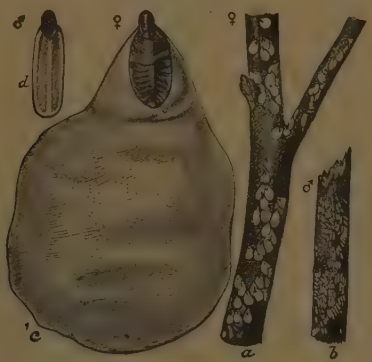

Fig. 28.—Scurfy bark-louse: a. c. females: b. d. males. a. b. natural size: c. d. much enlarged. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

end which usually points upward. The color is light grey or white. The male scale is much smaller than the female, pure white, with three parallel ridges along the back, and parallel sides. Males and females usually occur on separate twigs. Both sexes are shown in figure 28.

There is only one generation each year in Connecticut. The eggs hatch during the latter part of May. Our records show that on May 19th, 1902, material was brought to the Station from North Guilford, and that some of the eggs had hatched.

* Year-book, 1894, U. S. Department of Agriculture, p. 259, Washington, D. C.

The writer has made observations on this point for several years and usually the eggs hatch here between May 20th and June 1st.

The newly-hatched insect (see figure 29, c) crawls about for a short time, then becomes fixed, forms a shell and sucks the sap

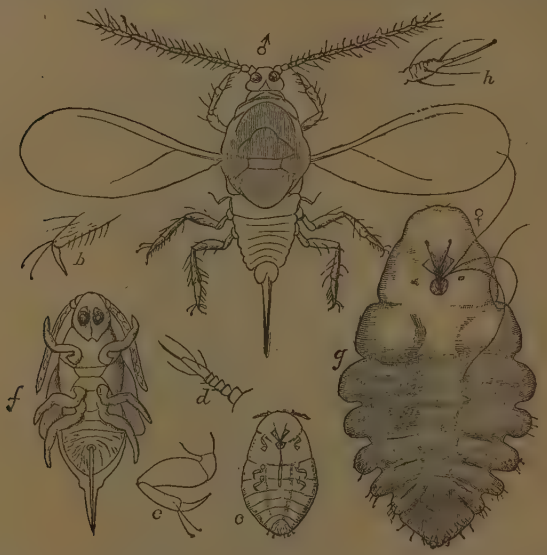

FIG. 29.—Scurfy bark-louse: adult male above: b. foot: h. tip of antenna: c. larva: d. antenna of larva: e. leg of larva: f. pupa: g. adult female with armor removed. All greatly enlarged. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

from the tree. The female becomes mature during September, and later dies and shrivels up, leaving the old shell filled with oval, purple eggs. Usually between thirty and fifty eggs are produced by each female. In Connecticut the writer found the eggs as early as October 1st in 1900, while they had not been formed on October 9th, 1901. Usually they are formed during the first week in October. Howard states that in the vicinity of Washington the eggs are formed October 15th and hatch uniformly about the middle of May.* There is probably more than one brood in the Southern States.

* *Loc. cit.*

The chief injury caused by this species occurs to young pear and apple trees either in nursery rows or in newly-set orchards. Sometimes the bark of the trunk and branches is entirely covered by the grey shells, thus giving the tree the appearance of having been whitewashed. Such trees make little growth and are frequently killed outright. Seldom do we find the insect abundant on large trees. Currant bushes are often infested and mountain ash and hawthorn are frequently attacked by the scurfy bark-louse. The appearance of an infested currant twig is shown on Plate I.

The Oyster-Shell Bark-Louse.

This insect is well known and occurs all over the world. Europe is thought to be its original home, but it has been known to be present in the United States for over one hundred

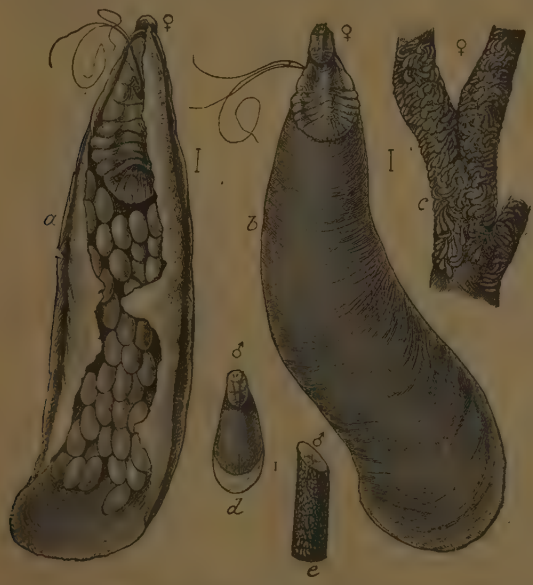

Fig. 30.—Oyster-shell bark-louse: a. female scale from below showing eggs: b. dorsal view of same: d. male scale—all enlarged: c. females; e. males—natural size on twigs. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

years. It is more common at the North, where it is single-brooded, than in the South, where two generations occur each year.

The armor of the female (shown in figure 30) is about 3 mm. (⅛ inch) long, narrow and usually somewhat curved, and nearly the same color as the bark upon which it is found. The cast

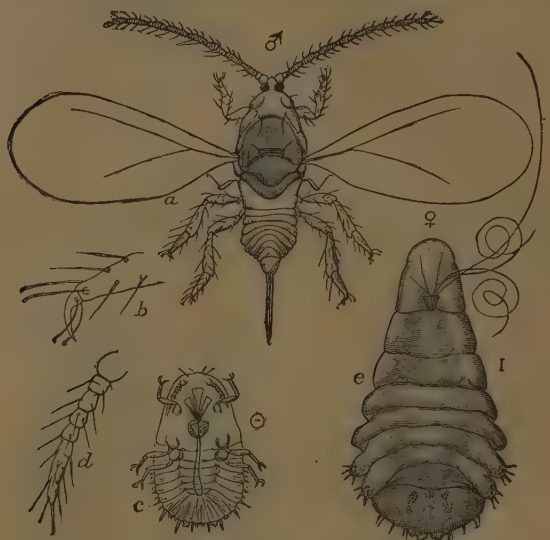

FIG. 31.—Oyster-shell bark-louse: a. adult male: b. foot: c. larva; d. antenna of larva: e. adult female with armor removed. All greatly enlarged. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

larval skin may be seen at the pointed end. Generally it is darker in color than the scurfy bark-louse, as well as narrower. The armor of the male is much smaller and less curved than that of the female. The male scales are seldom seen upon fruit trees. The adult male (shown in figure 31) is provided with a pair of wings, legs, antennæ and eyes, and resembles the male of the scurfy bark-louse.

The oyster-shell bark-louse, like the scurfy bark-louse, passes the winter in the egg stage and the small, oval, white or pale yellow eggs hatch about the first of June or a few days later than the eggs of the scurfy bark-louse. The young were

crawling on twigs received at the Station June 9th, 1902. As many as one hundred eggs are sometimes laid by a single female.

No observations have been made by the writer regarding the time when the eggs are laid in the fall, but eggs were formed in specimens collected in December. According to Smith the eggs are formed late in August and during September.*

The oyster-shell bark-louse is found on nearly every old apple tree in Connecticut, and may occur on the small twigs and on the large branches and trunk in the crevices of the rough bark. It weakens trees unquestionably, but the writer has never seen fruit trees killed by the oyster-shell bark-louse in Connecticut. Many seedlings and sprouts of native trees in fields and woods are killed each year by it. Ash, poplar, willow, birch, butternut, black-walnut and maple are the trees most commonly injured, and are frequently infested to such an extent that no portion of the bark can be seen.

In nurseries and ornamental plantations lilac, Kilmarnock willow and some species of *Elæagnus* are often seriously infested.

The appearance of twigs and branches infested by the oyster-shell bark-louse is shown on Plate II.

Remedies.

The eggs of both the scurfy and the oyster-shell bark-lice are hard to kill, so that winter applications are not effective in fighting the species. Some writers advise a winter application of whitewash to destroy them: this frequently causes the shells to fall from the bark and the eggs are scattered, and perhaps to such an extent that the young are not able to reach the tree. But many eggs remain on the tree and are not injured by the whitewash. Frequently these eggs withstand applications of kerosene and crude oil. The most vulnerable point in the life history of both species is just after the eggs hatch, while the young are crawling and before they have become protected by the formation of their shells or armor. In Connecticut this period occurs during the first half of June, and the newly-hatched insects may be destroyed readily by spraying with any

* Bull. 140, New Jersey Exp. Station, p. 5.

of the common contact insecticides. Common soap and water (1 lb. dissolved in 8 gallons) is as convenient as any application and is cheap and effective. Any laundry soap will answer. It should be cut in thin slices, dissolved in boiling water and diluted to make the proper proportions. Whale-oil soap in the same proportions can also be used. Kerosene emulsion is recommended, and a mechanical mixture of kerosene and water, containing from 10 to 15 per cent. of kerosene, applied with a "Kerowater" pump, is also a cheap and satisfactory remedy.

SUMMARY.

1. The scurfy bark-louse and oyster-shell bark-louse have commonly injured fruit trees for many years in Connecticut by sucking out the sap and are often mistaken for the San José scale-insect, which, on account of a different life-history, must receive different treatment.

2. The scurfy bark-louse is a native of North America and is well distributed over the United States. The female is light grey and pear-shaped, while the male is much smaller, white with parallel sides. There is one brood each year at the North. It winters in the egg stage and the eggs hatch during the latter part of May. Eggs for the next brood are laid the first week in October. Small apple and pear trees and currant bushes are the most seriously infested and are sometimes killed.

3. The oyster-shell bark-louse is found all over the world, and was probably introduced into this country from Europe more than a hundred years ago. It is darker in color and narrower than the scurfy bark-louse; the life history is very similar, but the eggs are a few days later in hatching, and are formed earlier in the fall. There is one brood each year. It infests apple, but is common on ash, poplar, willow, butternut and lilac, often killing them.

4. Spraying the trees during the first two weeks in June, or while the young are crawling, with soap and water (1 lb. in 8 gals.) or with kerosene emulsion will readily destroy the newly-hatched larvæ.

FIGHTING THE SAN JOSÉ SCALE-INSECT IN 1903.*

By W. E. Britton and B. H. Walden.

During the season of 1903, spraying experiments directed against this most destructive insect were conducted at Yalesville, Southington, Westville and New Haven.

One of the most extensive spraying operations ever conducted in the state was carried out at the orchard of Barnes Brothers at Yalesville. A short account of the work done in this orchard in 1902 was given in the Second Report of the State Entomologist, page 120. During March and April of the present year, about 11,000 trees were sprayed by the owners, and a brief account has been published in the Report of the Connecticut Pomological Society for 1902, page 217.

Barnes Brothers cordially coöperated with the Station in experimenting with various mixtures, and especially in developing practical methods of preparing and applying them, in order to make the work of greater value to the orchardists of the State.

At Southington, the writers sprayed over 200 peach and 50 apple trees with various substances during the latter part of March. Some of the mixtures were not effective in killing the scales and 100 of the peach trees were again sprayed August 10th, to prevent the further increase of the insects.

Various spraying mixtures were tested on about 150 pear trees in Westville on April 1st.

Late in the winter some fruit trees upon the Station grounds were found to be moderately infested, and several preparations were here applied to 35 trees of various kinds during March and April.

The results of the experiments have been tabulated and these, together with a somewhat detailed account of the conditions under which they were made, as well as a few practical directions for doing the work, appear in the following pages.

Spraying Dormant Trees.

Most of the experimental work consisted in spraying the dormant trees in late winter or early spring with various insec-

* This was published as Bulletin 144, in October, in an edition of 12,000 copies. It is here reproduced with appropriate emendations.

ticides. The results of the spraying are measured by the proportion of scale-insects which are killed by it. But since from fifteen to thirty per cent. of the scales usually die each winter, and sometimes even fifty per cent., it is necessary first to determine the percentage which are alive when the spraying is done.

In each case, therefore, before spraying, sample twigs were cut from marked trees and the percentage of living scales determined. Twigs from the same trees were taken some six or eight weeks after treatment to determine the effect of the insecticides.

This second count was made during June in all cases. At this time the hibernating males had reached maturity and had emerged, nothing but the shells remaining. These can readily be distinguished from the females by their different shape, and were not counted in determining the percentages. Though this method of indicating results has its faults and should not be the only kind of record kept, it furnishes, nevertheless, a means of expressing the results in a mathematical statement, and when combined with the method of frequently examining the trees, is believed to afford a more accurate account than can come from a personal estimate not based upon an actual enumeration.

In all of the work herein described, the trees were sprayed as well as could be, but on account of winds it was almost impossible some days to thoroughly coat the trees. After the first application dried, the trees were again visited and all branches not coated the first time were "touched up."

Experiments at Yalesville.

The work here was done on a very extensive scale by the owners. Throughout the orchards, infested trees could be found here and there, but very few were badly infested and no portion of the orchard was thoroughly or uniformly infested. On most trees the insect could not be found. The owners, wishing to check the pest before the trees were seriously injured by it, sprayed nearly their entire orchards.

Under these conditions, it was impracticable to test many different insecticides as the infested trees were widely scattered, and it was difficult to find many infested trees from which to cut twigs, especially after the trees had been pruned. It was

an excellent opportunity, however, to test practically the methods of making and applying insecticides on a large scale.

A description of Barnes Brothers' steam cooking plant for making the lime, sulphur and salt mixture (California wash) was published in the Second Report of the State Entomologist, 1902, page 120, and the boiler was figured on Plate III of the same.

This outfit was used in the season of 1903, but the boiler was supplemented by the boiler of a Kinney "Safe" engine in order to increase its capacity. Three hand barrel pumps were used for spraying, each pump being fitted with a 25-foot half-inch hose, 8-foot gas-pipe extension and double Vermorel nozzle. The barrels were mounted upon stone-drags, fitted with heavy wooden blocks hollowed out in such a manner as to prevent the barrel from slipping out of place. When spraying the trees near the cooking plant, the barrels were filled directly from it, but the mixture was carted to distant portions of the orchard in storage barrels, from which it was drawn into the pump barrels. The storage barrels and mounted pump are shown on Plate IV, b.

About half of the trees, which had been planted six and seven years, were severely cut back before spraying. As the fruit-buds had nearly all been winter-killed, the time was a very good one for heading back the trees (see Plate III, a). It was also possible to spray the trees more thoroughly and cheaply after cutting them back.

Nevertheless, the treatment of this orchard was expensive, as is shown by the figures kindly submitted by Mr. Barnes.

Labor	$472.80
Four horses, 75 cents each per day, 30 days	90.00
Materials—16,500 lbs. lime, 13,680 lbs. sulphur, 7,840 lbs. salt	500.00
Fuel—(besides wood) 3 tons coal	20.00
Sundry expenses for repairs, etc.	25.00
Charge to cover deterioration in plant	50.00
Total	$1,157.80
Number of trees sprayed, about	11,000
Average cost per tree, about	10 cents

These figures include the spraying of many large bearing apple trees which were growing in the peach orchard.

TABLE I.—YALESVILLE EXPERIMENTS. DORMANT TREES SPRAYED MARCH 10–12, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
1	Peach.		Moderately infested.	Lime, Sulphur, Salt. Formula No. 1.	23.2	67.8	9.	88	No injury.
2	"		"	20 lbs. lime.	18.8	77.9	3.5	96	"
3	"		"	14 lbs. sulphur.	19.7	73.3	7.	92	"
4	"		"	10 lbs. salt.	22.8	64.2	13.	83	"
5	"		"	40 galls. water.	18.5	77.5	4.	95	"
6	"		"	"	23.	----	----	----	----
7	"		"	"	21.3	----	----	----	----
14	"		"	"	19.	74.	7.	91	"
15	"		"	"	23.6	----	----	----	----
Average					21.1	72.4	6.9	91	
8	Peach.		Moderately infested.	Formula No. 2. 20 lbs. lime.	12.4	83.1	4.7	94	"
9	"		"	20 lbs. sulphur.	25.	----	----	----	----
10	"		"	10 lbs. salt.	20.6	----	----	----	----
11	"		"	40 galls. water.	13.5	83.5	3.	96	"
12	"		"	"	25.7	64.3	10.	86	"
13	"	11,000	"	"	20.	----	----	----	----
Average					19.5	76.9	5.9	92	

TABLE II.—YALESVILLE EXPERIMENTS. DORMANT TREES SPRAYED MARCH 20,* 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
16	Peach.		Moderately infested.	Lime and Sulphur.	25.9	74.1	0	100	No injury.
17	"		"	20 lbs. lime.	21.9	73.1	5	93	"
18	"		"	14 lbs. sulphur.	18.4	81.6	0	100	"
19	"		"	40 galls. water.	15.6	83.4	1	98	"
20	"		"	"	29.4	70.6	0	100	"
21	"		"	"	22.9	77.1	0	100	"
22	"		"	"	20.7	76.3	3	96	"
23	"		"	"	15.5	83.9	0.6	99	"
24	"		"	"	22.3	77.7	0	100	"
25	"		"	"	17.9	82.1	0	100	"
26	"		"	"	17.	83.	0	100	"
27	"	25	"	"	18.6	81.4	0	100	"
Average					20.5	78.6	0.8	98	

* These trees were not well coated on March 20th on account of winds, and were again sprayed in April with a mixture containing salt.

The average cost per tree could have been lessened by using two lines of hose on each pump, as one man can easily pump for two lines of hose.

Most of the orchard was sprayed with a mixture containing 20 pounds lime, 14 pounds sulphur, 10 pounds salt and 40 gallons water. The lime was slaked carefully, the sulphur and salt added and the whole boiled slowly for about one and one-half hours.

A portion of the orchard was sprayed with this mixture in November and December, 1902, but as an examination in March showed that there were still many living insects, these trees were again sprayed during the spring.

About thirty days, with the entire force at work, were required to spray the 11,000 trees.

Results at Yalesville.

The buds were well developed and were opening before the spraying could be finished. Some of these were injured. Otherwise there was no injury to the trees.

The percentages of insects living on June 17th, given in Tables I and II, probably do not represent accurately the number that brought forth young this season, for some of these were not healthy when examined and doubtless would not be able to reproduce. An examination of the orchard on September 11th, nearly three months after the breeding season began, showed that the results had been generally satisfactory, as it was extremely difficult to find living scales on the sprayed trees. None were found on the trees which were sprayed twice (December and April).

Very little difference could be seen in the effects of mixtures containing different quantities of sulphur.

A portion of the orchard was sprayed very late just before the leaves appeared, and some trees were in blossom. The open buds were destroyed, but the mixture remained for a longer time on these trees, doubtless on account of being protected by the foliage. Six months after spraying, the trunks and larger branches were still white.

One small orchard owned by Barnes Brothers was not sprayed at all, and Mr. Barnes states that this orchard produced peaches

that were badly infested with the "scab" fungus. Fruit of the same variety from a near-by sprayed orchard was almost entirely free from "scab," indicating strongly that the lime, sulphur and salt mixture, as had been supposed, is of considerable value as a fungicide.

Westville Experiments.

The trees that were here treated were all pear, and set in nearly a square block having fifteen rows with ten to eleven trees in each row. Nearly all of the trees were badly infested and some had been killed by the scale and were removed, so that only 144 trees were actually sprayed in this experiment. The scales had completely encrusted many trees and greatly impaired their vitality: otherwise the conditions were favorable for experimental spraying work.

The spraying was done on April 1st, a bright sunny day, with a breeze from the northwest. The orchard was divided into sections for treatment with the different insecticides. Beginning on the west side, the first row of nine trees was sprayed with Derrick crude oil and water (25 per cent. oil) applied with a "Success" kerosene bucket sprayer. The second, third, fourth and fifth rows were sprayed with whitewash, using 20 pounds of lime to 40 gallons of water. The sixth row was sprayed with sulphide of potash and lime in water (5 pounds sulphide of potash, 5 pounds of lime, 10 gallons of water). The seventh and eighth rows were sprayed with strong Bordeaux mixture composed of 5 pounds of copper sulphate, 5 pounds of lime and 20 gallons of water.

The ninth, tenth, eleventh and twelfth rows were sprayed with the lime and sulphur mixture (no salt), containing 20 pounds of lime, 14 pounds of sulphur and 40 gallons of water, the lime and sulphur being boiled together in a concentrated solution for one hour.

The thirteenth, fourteenth and fifteenth rows were sprayed with the regular lime, sulphur and salt mixture, made by boiling together for one hour 20 pounds of lime, 14 pounds of sulphur, 10 pounds of salt and enough water added to make 40 gallons.

The lime, sulphur and salt, and the lime and sulphur mixtures were boiled for about one hour in a large iron kettle devised for cooking stock feed.

TABLE III.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 1, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
82	Pear.		Badly infested.	20 p. c. Crude Oil in water.	24.	76.	0	100	No apparent injury.
83	"		"	"	24 6	75.4	0	100	"
84	"		"	"	21.8	78.2	0	100	"
85	"		"	"	17.	83.	0	100	
86	"		"	"	38.	62.	0	100	
87	"		"	"	36.5	63.5	0	100	"
88	"	9	"	"	37.	63.	0	100	"
Average					28.4	71.6	0	100	
103	Pear.		Badly infested.	Lime and Sulphide of Potash	23.	69.	8.	89	"
106	"		"	10 lbs. sulphide of potash,	43.6	54.9	1.5	97	"
107	"	11	"	10 lbs. lime, 20 galls. water.	17.	72.	11.	86	"
Average					27.5	65.3	6.8	91	
104	Pear.		Badly infested.	Strong Bordeaux Mixture.	25.9	62.1	12.	83	"
105	"		"	5 lbs. copper sulphate.	24.7	66.4	8.9	88	"
108	"		"	5 lbs. lime.	24.	56.	20.	74	"
109	"		"	20 galls. water.	30.9	65.1	4.	93	"
110	"		"	"	27.	62.	11.	85	"
111	"	20	"	"	12.3	77.7	10.	88	"
Average					24.1	64.9	10.9	85	

TABLE IV.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 1, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
89	Pear.		Badly infested.	Whitewash.	36.8	39.2	24.	62	No apparent injury.
90	"		"	20 lbs. lime.	35.5	50.5	14.	78	"
91	"		"	40 galls. water.	26.4	60.6	13.	82	"
92	"		"	"	24.	51.	25.	67	"
93	"		"	"	19.4	66.6	14.	82	"
94	"		"	"	28.	52.	20.	72	"
95	"		"	"	32.	54.	14.	80	"
96	"		"	"	34.8	36.2	29.	55	"
97	"		"	"	18.9	65.1	16.	80	"
98	"		"	"	24.	68.	8.	90	"
99	"		"	"	29.	25.	46.	35	"
100	"		"	"	24.	54.	22.	71	"
101	"	37	"	"	32.8	57.2	10.	85	"
Average					**28.1**	**52.2**	**19.**	**72**	

TABLE V.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 1, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
112	Pear.		Badly infested.	Lime and Sulphur.	25.	64.	11.	85	No apparent injury.
113	"		"	20 lbs. lime.	22.	66.	12.	84	"
114	"		"	14 lbs. sulphur.	37.	58.	5.	92	"
115	"		"	40 galls. water.	25.6	64.4	10.	86	"
116	"		"	"	26.5	60.5	13.	82	"
117	"		"	"	22.	75.	3.	96	"
118	"		"	"	32.5	45.5	22.	67	"
119	"		"	"	33.	63.	4.	94	"
120	"		"	"	24.	70.	6.	90	"
121	"		"	"	20.5	72.5	7.	91	"
122	"		"	"	25.	67.7	7.3	90	"
123	"	39	"	"	30.	68.1	1.9	97	"
Average					**26.7**	**64.5**	**8.5**	**88**	
124	Pear.		Badly infested.	Lime, Sulphur, Salt.	26.9	70.1	3.	95	No apparent injury.
125	"		"	20 lbs. lime.	23.9	72.1	4.	94	"
126	"		"	14 lbs. sulphur.	25.	67.4	7.6	89	"
127	"		"	10 lbs. salt.	33.	65.	2.	97	"
128	"		"	40 galls. water.	30.9	65.1	4.	94	"
129	"		"	"	14.	83.2	2.8	96	"
130	"		"	"	31.	58.	11.	84	"
131	"	28	"	"	21.5	76.5	2.5	97	"
Average					**25.7**	**69.8**	**4.8**	**93**	

With the exception of the oil, all the spraying was done with an "Eclipse" barrel pump mounted on a two-wheeled cart and fitted with two lines of hose, bamboo extensions and double Vermorel nozzles.

Results at Westville.

The first row of trees sprayed with 25 per cent. crude oil mixed with water apparently suffered no injury from the treatment and no living insects could be found on the twigs examined. In former experiments, however, trees have been injured by oils, and in other states, notably Ohio, orchards have been seriously damaged by their use. The pumps for mixing oil and water are not reliable, and for these reasons the oils must be used cautiously in Connecticut.

The whitewash alone was not a success, because it washed off quickly and did not kill the scales. If it could be made to remain upon the trees as a coating until after the breeding season begins, it might be of considerable value as a mechanical barrier to the emergence of the young insects. A considerable number (ranging from 8 to 46, with an average of 19, per cent.) of the female scales were not killed by the whitewash.

Similar, though somewhat more satisfactory results, were obtained from the use of the strong Bordeaux mixture. This remained on the trees for a much longer time than the whitewash. But the cost of this mixture together with the results obtained do not warrant its use as a spray to kill the San José scale-insect.

The lime, sulphur and salt mixture made by boiling gave fairly satisfactory results, though more living insects were found than where the oil was applied. The trees remained white for quite a long time, and some of the mixture could still be seen on the under sides of the branches when the trees were examined on September 14th.

What has been said of the results attending the application of the lime, sulphur and salt mixture is also true of the sulphide of potash and lime, prepared without boiling. This was effective in killing the scales and did not wash off badly. It is too expensive for common orchard spraying, but is a convenience when only small quantities of the mixture are required.

The lime and sulphur (no salt) remained on the trees better than any other preparation except the strong Bordeaux mixture, but a larger percentage of insects survived than was the case where salt was used.

The results of the Westville experiments cannot be called satisfactory. Owing to the badly infested condition of the trees, more scales survived the treatment than in the other experiments. It is evident that the lime, sulphur and salt mixture, which forms a hard coating over the branches, does not have the penetrating power of the oils, and therefore is less effective where the trees are covered with several layers of scale-insects.

In such cases it would seem best to give two treatments with the lime, sulphur and salt where feasible—one in the fall soon after the leaves drop and another in spring just before the leaves appear.

Spraying at Southington.

Most of the trees sprayed were in a small peach orchard containing 200 trees. Fifty good-sized apple trees near-by were also treated. The peach trees were all infested by the scale-insect, though most of them had not been greatly injured. It was possible to find scales on nearly every tree. The orchard was on level ground and the trees were not large, making it an ideal place to conduct spraying experiments.

A man and pair of horses were hired for carting the water and the spraying mixture, and a Kinney "Safe" steam engine was hired from the town to boil the lime, sulphur and salt mixture. By attaching two lines of hose to the boiler, the mixture was boiled in two barrels at once, each barrel containing enough materials to make two barrels of mixture when diluted ready for application. The capacity of the boiler was sufficient to do twice the amount of work, as the steam had to be nearly shut off in order to prevent a too violent agitation of the liquid. The engine with boiler is shown mounted on a wagon on Plate IV, a.

The spraying pump and barrel were mounted upon a wagon and two lines of hose used at the same time, as is shown on Plate V, a. The mixtures used were: Whitewash—20 pounds lime, 40 gallons water; lime, sulphur and salt—20 pounds lime, 14 pounds sulphur, 10 pounds salt, 40 gallons water; lime and sulphur—20 pounds lime, 14 pounds sulphur, 40 gallons water;

TABLE VI.—EXPERIMENTS AT SOUTHINGTON. DORMANT TREES SPRAYED MARCH 26–28, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
28	Peach.		Thoroughly infested but not seriously injured.	Whitewash. 20 lbs. lime. 40 galls. water.	12.	69.	19.	78	No injury.
29	"				15.5	59.5	25.	70	"
33	"				18.	60.	22.	73	"
34	"		"	"	12.	63.	25.	71	"
35	"		"	"	16.	64.	20.	76	"
38	"		"	"	24.4	56.6	19.	74	"
39	"		"	"	27.	25.	48.	34	"
40	"		"	"	23.3	66.7	10.	86	"
44	"		"	"	17.7	61.3	21.	74	"
45	"		"	"	18.	62.	19.	75	"
46	"		"	"	28.7	46.3	25.	65	"
48	"		"	"	25.4	53.6	21.	71	"
50	"		"	"	25.	59.	16.	78	"
51	"		"	"	24.7	34.3	41.	45	"
58	"		"	"	20.5	44.5	25.	56	"
59	"		"	"	39.	46.	15.	75	"
60	"		"	"	17.	67.	16.	80	"
61	"		"	"	22.	58.	20.	74	"
62	"	100	"	"	26.6	60.4	13.	82	"
Average					21.7	55.5	22.	70	

TABLE VII.—EXPERIMENTS AT SOUTHINGTON. DORMANT TREES SPRAYED MARCH 26–28, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
30	Peach.		Thoroughly infested,	Lime and	13.7	81.3	5.	94	No injury.
31	"		but not greatly in-	Sulphide of Potash.	18.	81.1	0.9	99	"
64	"		jured.	10 lbs. sul. potash.	25.	71.6	3.4	95	"
65	"		"	10 lbs. lime.	27.	72.	1.	98	"
66	"	12	"	20 galls. water.	19.8	80.2	0	100	"
Average					**20.7**	**77.2**	**2.**	**97**	
32	Peach.		Thoroughly infested,	Lime and Sulphur.	25.	72.	3.	96	"
37	"		but not greatly in-	20 lbs. lime.	23.	73.4	3.6	95	"
41	"		jured.	14 lbs. sulphur.	24.	72.	4.	94	"
42	"		"	40 galls. water.	20.	79.4	0.6	99	"
43	"		"	"	25.	73.	2.	97	"
67	"		"	"	25.8	70.4	3.8	94	"
68	"	61	"	"	18.	80.	2.	97	"
Average					**22.9**	**74.3**	**2.7**	**96**	

TABLE VIII.—EXPERIMENTS AT SOUTHINGTON. DORMANT TREES SPRAYED MARCH 26–28, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
54	Peach.		Thoroughly infested,	Lime, Sulphur, Salt.	27.	71.	2.	97	No injury.
55	"		but not greatly in-		21.	77.	2.	97	"
57	"		jured.	20 lbs. lime.	31.	67.	2.	97	"
68	"		"	14 lbs. sulphur.	25.9	72.7	1.4	98	"
69	"		"	10 lbs. salt.	20.7	76.8	2.5	96	"
70	"		"	40 galls. water.	29.7	69.7	0.6	99	"
71	"	27	"	"	29.6	70.4	0	100	"
73	Apple.		"	"	40.9	57.1	2.	96	"
74	"		"	"	66.6	30.6	2.8	91	"
75	"		"	"	65.	31.	4.	88	"
76	"		"	"	50.	*	----	----	
77	"		"	"	42.6	55.4	2.	96	"
78	"		"	"	20.	75.2	4.8	94	"
79	"		"	"	57.6	39.7	2.7	93	"
80	"	50	"	"	66.	30.7	3.7	90	"
Average					39.5	58.8	2.3	95	

* Tree dead. Killed by scale-insect.

and lime and potassium sulphide—20 pounds lime, 20 pounds potassium sulphide, 40 gallons water. It was planned to use 25 per cent. of crude oil on a few trees, but the pump was not working properly on the days the spraying was done, and this had to be abandoned.

The trees were sprayed on March 26, 27 and 28, during fine weather, though a shower stopped the work before the apple trees were finished late in the afternoon of March 28.

The results are tabulated on pp. 245, 246 and 247.

Results at Southington.

The results obtained from the whitewash are disappointing. It did not remain long upon the trees and was not effective in destroying the scales. The trees were sprayed with kerosene emulsion in August (see page 252).

The lime, sulphur and salt, the lime and sulphur, and the lime and potassium sulphide mixtures were destructive to the scale and remained upon the trees for a long time. In fact, it was quite noticeable on the under sides of the branches when the orchard was visited on September 9th, and living scale-insects were very scarce on the trees in spite of the fact that badly infested trees were not far distant.

New Haven Experiments.

It has been stated on page 233 that the fruit trees on the Station grounds were found to be infested. The discovery was made late in the season, but not too late to spray the trees before the leaves appeared. None of the fruit trees were badly infested though nearly all were infested to a slight degree.

Most of these trees (27) were sprayed with the lime, sulphur and salt mixture, 6 with whitewash and 2 with the Oregon wash (lime, sulphur and copper sulphate mixture). The lime, sulphur and salt mixture was boiled in barrels with steam from the heating system.

The following table gives the chief data:—

TABLE IX.—NEW HAVEN EXPERIMENTS. DORMANT TREES SPRAYED MARCH AND APRIL, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
132	Apple.	8	Slightly infested.	Lime, Sulphur, Salt. 20 lbs. lime. 14 lbs. sulphur. 10 lbs. salt. 40 galls. water.	10.	85.	5.	96	No injury.
	Pear.	11	"	"					"
	Plum.	2	"	"					"
	Peach.	4	"	"					"
	Cherry.	2	"	"					"
133	Willow.	1	Badly infested.	Lime, Sulphur and Copper Sulphate. 20 lbs. lime. 14 lbs. sulphur. 10 lbs. cop. sul. 40 galls. water.	32.	61.4	6.6	90	"
134	Apple.	1	Slightly infested.	"	25.	50.	25.	50	"
Average					28.5	55.7	15.8	70	
	Pear.	6	Slightly infested.	Whitewash. 20 lbs. lime. 40 galls. water.	----	----	----	----	"
		35							

Results at New Haven.

Trees sprayed with the whitewash were so slightly infested that it was difficult to find specimens upon the twigs. They appeared very white when first sprayed, but the coating soon washed off and disappeared long before the lime, sulphur and salt.

The mixture containing copper sulphate in place of salt (Oregon wash) was dark-green or nearly black in color and could scarcely be seen on the bark. This also washed off early, though in one case it was fairly effective in destroying the scales.

The lime, sulphur and salt, however, was the most satisfactory of the three mixtures used at the Station.

TABLE X.—PERCENTAGE EFFICIENCY OF INSECTICIDES.

Materials.	Percentage Efficiency of Insecticides at				Average for these localities.
	Yalesville.	Westville.	Southington.	New Haven.	
Lime, Sulphur and Salt, Formula No. 1	91	93	95	96	94.5
" " " No. 2	92	--	--	--	--
Lime and Sulphur	98	88	96	--	94
Lime, Sulphur and Copper Sulphate	--	--	--	70	--
Lime and Sulphide of Potash	--	91	97	--	94
Strong Bordeaux Mixture	--	85	--	--	85
Whitewash	--	72	70	--	71
Twenty-five per cent. Crude Oil in water	--	100	--	--	--

Other Experiences.

Several small trees including peach, cherry, pear, Japan plum, and hawthorn in a New Haven city garden were sprayed with the lime, sulphur and salt mixture on January 19th.

The mixture was boiled in a kettle on the kitchen range and applied thoroughly. Though the mixture seemed to become well dried upon the trees, a heavy rain fell on the 21st and it washed off badly. Two months after applying, no traces of the spray could be seen on the trees, and a very large proportion of the scales were not killed, as the trees were very badly infested during the latter part of the summer.

In another yard six small trees, including quince, pear, apple and peach, were sprayed on March 18th, with the lime, sulphur and salt mixture.

Though some of the trees were quite badly infested, the treatment seems to have been successful, as very few living scales could be found when the trees were examined on September 15th.

Considerable spraying with the lime, sulphur and salt mixture was done in the large orchards of the state. George F. Platt & Son of Milford sprayed 8,000 peach trees last spring just before the buds started, at a cost of two cents per tree. While the results were generally satisfactory, many scales survived and multiplied rapidly during the season on account of unfavorable weather and high winds at spraying time. The owners intend to spray the orchard again as soon as the leaves fall this autumn.

Mr. J. H. Hale of South Glastonbury sprayed about 11,000 trees with the mixture, with satisfactory results.

N. D. Platt & Son of Milford sprayed about 800 six-year-old peach trees at a cost of about six cents per tree. The results were successful.

Mr. N. H. Sherwood of Southport sprayed his entire orchard of 2,200 peach trees with lime, sulphur and salt with satisfactory results.

One grower of West Hartford sprayed a few trees, using 150 gallons of the mixture. The work was satisfactory, as nearly all of the scales were killed. The treatment will be repeated next season. Another West Hartford peach grower reported that 1,000 of his trees were sprayed with the mixture during early spring with successful results in killing the scale. 1,000 trees were sprayed in Cromwell, and many other growers have each used the mixture on a smaller number of trees.

In the orchard of the Highland Fruit Co. at Wallingford, 1,200 five-year-old peach trees were sprayed with 25 per cent. crude oil in the spring of 1903. The work was done thoroughly, the results were satisfactory, and the cost was three cents per tree on the average.

Mr. Linus H. Hall of Wallingford reports that 1,200 large trees in his orchard have been sprayed for two seasons with 25 per cent. crude oil. The average cost was three and one-half cents per tree for each treatment, and the results were fairly satisfactory.

Mr. Z. P. Beach of Wallingford has done more or less spray-

ing with 25 per cent. crude oil each year for three years in his orchard of 4,500 peach trees, all of the trees being sprayed in 1902. The scale has been held in check and only a few trees injured by the oil.

Summer Spraying with Kerosene Emulsion.

After it was found that the whitewash applied to the peach trees at Southington had proved unsuccessful in destroying the scale-insects, kerosene emulsion was applied on August 10th, to kill the young and prevent to some extent the very rapid multiplication of the scales for the season.

As the pumps for making a mechanical emulsion were not in working condition, it was necessary to prepare a soap emulsion. Two formulas were employed:

No. 1.	½ lb. common soap 2 gallons kerosene 28 gallons water	6.6 per cent. kerosene.
No. 2.	¾ lb. common soap 6 gallons kerosene 34 gallons water	15 per cent. kerosene.

In each case the soap was dissolved in hot water, the oil added, and the whole churned violently for a short time until a white creamy mass formed, which was then diluted and applied.

Fourteen trees were sprayed with emulsion made from formula No. 1, and eighty-six trees with formula No. 2. No injury was done to the trees except possibly the dropping of a few leaves, but this was scarcely perceptible.

The results of this summer treatment were unsatisfactory. Though a large number of insects were killed, many came through alive and when the trees were examined on September 9th the young were numerous on these trees. Formula No. 1 killed about half the scales and formula No. 2 killed from two-thirds to four-fifths of them. But enough escaped to keep the trees badly infested.

Making the Lime, Sulphur and Salt Mixture.

The materials needed for making the lime, sulphur and salt mixture are: good fresh stone lime (the best grade finishing lime), sulphur flour, or the sublimed flowers of sulphur, and a cheap grade of salt. The agricultural or hay salt is commonly used.

While the operation is quite simple, much care should be used in making the mixture. We found that small quantities, sufficient to spray one or two hundred trees, could be boiled nicely over a fire in a set kettle, such as is used to heat water and cook feed for stock on many of the farms.

For making large quantities, however, it is necessary to boil it by steam from a boiler. Where a boiler is handy, it is an easy matter to procure the necessary barrels for holding the mixture and the hose to carry the steam from the boiler to the barrels. Often one can hire a small portable boiler for the occasion. Where spraying is done on an extensive scale, plants have been established for cooking the mixture in large quantities.

In whichever way the mixture is made, the process is similar and the same care should be taken in preparing it.

The formula used chiefly in our experimental work was 20 pounds lime, 14 pounds sulphur and 10 pounds salt to 40 gallons water. This is simply two-thirds the amount of the 30-20-15-60 formula, and is more convenient, as it just fills a barrel.

The lime should be thoroughly slaked. Much of the trouble in straining and also the clogging of the pumps is caused by the improper slaking of the lime.

The sulphur and salt are then added and the whole boiled for an hour or an hour and a half. The mixture should be kept well stirred all the while it is boiling; while the sublimed flowers of sulphur is more soluble than the sulphur flour, it is liable to form in lumps, which must be crushed against the sides of the kettle or barrel, and consequently it will be necessary to boil it as long as it will the sulphur flour.

After boiling, add water to make the right proportion.

The mixture should be strained through a strainer having about twenty meshes to the inch.

If the mixture has been thoroughly prepared, very little sediment will remain, and there will be no trouble from clogging the nozzles.

The pumps should be thoroughly cleaned every night after spraying. It has been recommended to run a little vinegar or some weak acid through the pump to neutralize the effects of the alkaline solution.

All receptacles should be iron or wood, the strainer iron or brass, and under no consideration should copper be used.

On May 12th, a piece of copper wire weighing 4½ grams was boiled for one hour in the lime, sulphur and salt mixture. During this time the weight had been reduced to 3½ grams by the corrosive action of the mixture. In standing three hours after boiling the weight was further decreased two-fifths of a gram.

At the same time brass wire weighing 6½ grams was boiled for one hour in the same kind of mixture with no decrease in weight.

The metals were allowed to stand in the mixture and were examined about September 1st. The brass was slightly corroded, but no trace of the metallic copper could be seen.

Laboratory tests were made with the different grades of sulphur, light sulphur flour, heavy sulphur flour, and flowers of sulphur. The two grades of flour are simply ground brimstone, the "light" being more finely ground than the "heavy." Flowers of sulphur is a sublimated product and the particles are smaller and of different shape than in sulphur flour, and can be readily distinguished under the microscope.

135 grams lime, 90 grams sulphur, and 68 grams salt were the quantities used in the test.

A contained heavy sulphur flour.
B contained light sulphur flour.
C contained flowers of sulphur.

The lime was slaked in each case and one-half pint of hot water added. C was the first to show discoloration due to chemical action. Each boiled at 102° C. After boiling for half an hour a half-pint of hot water was added to each. After boiling one hour, a preliminary test for sulphur was made. A, contained considerable, B, a very small quantity, and C, no undissolved sulphur.

The flowers of sulphur costs a little more than the sulphur flour, but is not so heavy.

Flowers of sulphur weighs	175	pounds	per	barrel.*	
Sulphur flour (light)	"	225	"	"	"
" " (heavy)	"	275	"	"	"

* These weights were given us by a local wholesale drug firm, but we have recently purchased flowers of sulphur put up in barrels of 150 pounds each.

The sulphur can be made into a paste before adding, may be slaked with the lime, or may be sifted upon the top of the liquid to avoid lumps.

Finishing lime is preferable as it is nearly pure lime, slakes completely, and contains less dirt than other grades. The lime used in the Southington experiments contained only 54.24 per cent. of lime and 36.04 per cent. of magnesia.

Making the Lime and Sulphide of Potash Mixture.

Sulphide of potash is commonly known as "liver of sulphur" and is sold by all druggists. It comes in the form of light yellowish brown lumps, and is put up in pound, five pound, and ten pound packages. Larger packages can doubtless be obtained if desired. It is readily soluble in water and the right quantity by weight should be dissolved in a barrel, pail or basin. The lime should be slaked in a separate receptacle and when both substances are in liquid form, put them together and add water to make the right proportions. In our experiments, twenty pounds each of lime and sulphide of potash to forty gallons of water were employed and the results were about as satisfactory as where the boiled mixture was used. The disadvantage of this mixture lies in the cost of the sulphide, making it too expensive for orchard spraying. It is very convenient, however, for a few small trees or shrubs in the village garden, and may be prepared by taking one pound each of lime and sulphide of potash to a pail of water.

Effect of the Lime and Sulphur Mixtures on the Skin.

The lime, sulphur and salt mixture is very irritating to the skin and causes smarting, and finally soreness if the spray is allowed continually to come in contact with the hands and face. Gloves should therefore be worn to protect the hands. For this purpose rubber or oil-skin is preferable. The mixture quickly ruins leather. Cheap masks may be used to protect the face, though this is hardly necessary if the operator keeps on the windward side of the tree when spraying.

Rubbing the face and hands with petrolatum before commencing work is also advisable.

Weather Notes.

One of the greatest drawbacks to using the lime, sulphur and salt mixture in the east is the rainy weather, early in spring common to this section. If the application is followed by a week or more of clear weather, the mixture is doubtless more effective than if rains occur soon after it is applied.

The mixture should at least have time to thoroughly dry upon the trees before it rains.

Notes were kept regarding the weather following our spraying experiments in March and April.

At Southington trees were sprayed on the 27th and 28th of March. About four o'clock on the afternoon of the 28th a brisk shower stopped the work. The 29th was clear. It rained the afternoon of the 30th and hard all night, followed by showers the 31st.

The first of April being a pleasant day, we sprayed at Westville. The 2d was clear and windy. It rained nearly all day the 3d, the 4th rain and snow. The 5th and 6th pleasant weather prevailed. The 7th and 8th were rainy, and in the evening of the 9th there was a heavy shower. From the 10th to the 14th was pleasant. The 15th and 16th were stormy. From April 17th to the 28th of May no rain fell, excepting May 4th, when we had a light shower that scarcely laid the dust.

For about three weeks following the spraying there was considerable rain, which washed much of the mixture from the trees, and doubtless affected somewhat the results of the experiments.

SUMMARY.

1. During the Spring of 1903, spraying experiments were conducted in Yalesville, Westville, Southington and New Haven, over 11,500 trees being treated. The trees were chiefly peach, pear and apple.

2. The chief mixtures used were: lime, sulphur and salt; lime and sulphur; lime, sulphur and copper sulphate; lime and potassium sulphide; whitewash; strong Bordeaux mixture; twenty-five per cent. crude oil in water, upon dormant trees, and kerosene soap emulsion upon trees in foliage.

3. Most of the trees were sprayed with the lime, sulphur and salt mixture (California wash): this and the lime and sulphur mixture, and the lime and potassium sulphide proved about equally effective in destroying the scales and in sticking to the trees. Apparently the salt is of no benefit either in making the mixture more destructive to

the scales or in rendering it more adhesive to the trees. Whitewash and strong Bordeaux mixture as used in these experiments were unsatisfactory scale-destroyers. The former soon disappeared from the trees while the latter remained about as long as the lime and sulphur mixtures. The Oregon wash (lime, sulphur and copper sulphate) soon disappeared from the trees, though in one case it was quite destructive to the scale-insects. Twenty-five per cent. crude oil in water must be regarded as an excellent scale-destroyer. Though no injury resulted to the trees in these experiments, many trees have been damaged here and in other states, and it is hardly a safe treatment for the average orchardist to use; but the oil mixtures have greater penetrating power than any of the lime and sulphur mixtures, and therefore may be expected to destroy a larger proportion of scale-insects on badly infested trees.

4. Several Connecticut orchardists have sprayed their orchards (containing nearly 40,000 trees) with the lime and sulphur mixtures with generally satisfactory results. Several thousand trees have also been sprayed with oil, with good results, though trees were injured in some cases.

5. The lime and sulphur mixtures remained upon the trees longest when applied just before the leaves appeared, being protected by them. In some cases it washed off and was not effective when applied in the winter.

In orchards where two applications were made (one in late fall and the other in early spring) it was difficult to find any living insects in June.

6. Kerosene emulsion as a summer spray was not particularly successful in our experiments.

POSTAL CARD BULLETIN ON THE SAN JOSÉ SCALE-INSECT AND THE ELM LEAF BEETLE.

The postal card bulletin is a convenient form in which to send out short statements of timely information. The following was issued in February in an edition of 11,000 copies:

POSTAL CARD BULLETIN.

This bulletin is not numbered or distributed with the regular bulletin series.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN., February 2, 1903.

SAN JOSÉ SCALE-INSECT. Now is the time to spray orchards, trees and shrubs to kill the San José Scale-insect. Destroy all worthless trees, prune the others, cutting them back severely if badly infested, and spray thoroughly with the lime, sulphur and salt mixture, which is prepared as follows: Slake 30 pounds fresh stone lime, add 20 pounds flowers of sulphur and 15 pounds common salt; cover with water and boil for at least one hour over a fire or with steam from a boiler. Then add water to make 60 gallons and spray while fresh upon the dormant trees.

FIG. 32. The San José Scale-Insect.

Twenty-five per cent. of crude oil mixed with water in a "Kerowater" pump may be used for the same purpose, but is liable to injure the trees, and should not be applied until just before the buds start.

ELM LEAF-BEETLE. Adult beetles are now hibernating in the towers of public buildings, belfries of churches, and attics of dwellings—in fact, in any building where they can find protection. These beetles are now in a dormant condition, but will become active in March and April, flying to the elms as soon as the leaves appear, and beginning anew their depredations. The beetle should not be confounded with the two-spotted red lady-beetle that hibernates in similar places, and which is a beneficial insect. By cleaning out all such places and destroying the beetles during the next month much can be accomplished toward preventing injury to the elm trees next summer.

FIG. 33. The Elm Leaf-Beetle.

W. E. BRITTON, *State Entomologist.*

THE GREEN APPLE LEAF APHIS.

Aphis pomi De Geer.

The apple leaf plant louse or aphis was remarkably abundant in 1903. The long period of dry weather in spring was doubtless favorable for the development of plant lice and they increased with great rapidity. Throughout the state orchards were considerably injured; the growth being checked by the thousands of plant lice which sucked the sap from the tender shoots and leaves. In most cases this aphis attacks the under side of the leaves, causing them to curl and appear as shown on Plate VI, a. Not only were orchard trees attacked, but the apple stock generally in the nurseries of Connecticut was below the usual size, on account of the injuries caused by this insect. Most nurserymen did not attempt to kill the lice on their nursery trees, though Barnes Brothers of Yalesville used kerosene emulsion rather extensively. The tops of the trees were bent over and dipped into the liquid.

FIG. 34. Eggs of green apple aphis as they appear on the twigs in winter.

The apple tree is attacked by several species of plant lice which have been greatly confused by various writers. Professor E. Dwight Sanderson, now State Entomologist of Texas, but formerly Entomologist of the Delaware Experiment Station, has recently made a study of the subject, and has described and named a number of new species.* The bibliographies given in Professor Sanderson's paper show that at least two species have very generally been known as *Aphis mali* Fabr., and a third, *A. sorbi* Kalt., has several times been included under the same name. Sanderson also shows that *A. mali* Fabr. is a synonym of *A. pomi* De Geer. One of the best accounts of the apple plant louse (as *Aphis mali*) that has appeared in recent years is given by Professor J. B. Smith† of New Jersey. Both Professor Smith and Professor Sanderson have followed the development of the insect through its different

* 13th Report Delaware Agr. Exp. Station for 1901, page 127.
† Bull. 143, New Jersey Agr. Exp. Station, 1900.

stages and generations. The present writer has not been able to do this, but the figures and the descriptions of the mature forms here given have been taken from material gathered upon the Station grounds in July. The notes on the immature forms and life history have been taken from the writings of Smith and Sanderson.

FIG. 35. The green apple aphis *A. pomi*. Wingless viviparous female, enlarged. Antenna, still further enlarged, is shown at left.

Appearance and Life History.

Though usually green, a bright yellow form of this species occurs on the apple. The green apple-leaf aphis can usually be distinguished from the other species found upon the apple by its long and straight, black, tapering cornicles or honey tubes. The species occurs in Europe, where it has been described by Kaltenbach, and it is doubtless common throughout the United States.

This species passes the winter in the egg stage upon the twigs of apple trees. The eggs are oval in shape, black, and shiny, and have the appearance shown in Figure 34. They are usually placed around the buds, in crotches, or crevices of the bark.

These eggs hatch in April, but according to Sanderson, the lice are not common on the buds and are seldom abundant until

after the foliage is well out in May. The lice are then found on the under surface and cause the leaves to curl badly, as shown on Plate VI, a. The lice are found upon the apple tree throughout the season, though the winged females of the second brood are said to migrate to other apple trees. Ten or more generations are produced each season, seven of which are parthenogenetic females. In October a sexual generation is developed and the females lay eggs for the following season. Egg-laying may be kept up until the middle of November, or further south until December.

FIG. 36. The green apple aphis *A. pomi*. Winged viviparous female, enlarged. At the left may be seen the third joint of the antenna with sensory pits—very much enlarged.

The wingless viviparous female is of a yellowish green color, with lighter-colored legs and antennæ; Cauda, cornicles, tarsi, knees and distal extremities of tibiae, dark. Body pyriform in shape, with cornicles or honey tubes long, reaching to the end of the abdomen, and tapering. See Figure 35.

The winged viviparous female is less than a tenth of an inch in length and has a wing expanse of about one-fourth of an inch. The body is somewhat darker in color than in the wingless form. The head and raised portions of the thorax are dark brown or black. Cauda, cornicles, knees, tarsi and distal third of the tibiae are brown or nearly black. Honey tubes long and tapering. See Figure 36.

Remedies.

Thorough and persistent spraying with soap and water or with kerosene emulsion is necessary to keep the apple leaf aphis in check. The few that escape death multiply so rapidly that the branches are again soon covered.

Natural enemies were surely at work, as the writer saw an abundance of lace-winged flies (*Chrysopa*) and several kinds of lady-beetles feeding upon the lice. Of the lady-beetles, the two-spotted lady beetle, *Adalia bipunctata,* seemed to be the most common. Larvæ of *Syrphus* flies were also abundant, and destroyed large numbers of the plant lice.

On May 6, a few tests were made of the effectiveness of soap and water in killing this aphis. The following records were taken from Mr. Walden's note book. In all cases the infested branches were dipped into the mixture.

1 lb. soap in 8 gallons water. Examined May 8, and found nearly all lice killed. The few living ones might have crawled from below the dipped portion.

1 lb. soap in 6 gallons water. Only a few living insects on May 8. Number somewhat smaller than in preceding.

1 lb. soap in 4 gallons water. Nearly as many living insects as where the weaker mixtures were used.

During the winter of 1902-3 the eggs were abundant on apple twigs.

We expected to find them also the following winter after their very great abundance and injury to the trees through the season, but examination of apple trees in and near New Haven shows, on the contrary, that the eggs are scarce. This indicates that the species may be less abundant the coming season.

THE PEAR PSYLLA.

Psylla pyricola Först.

The pear psylla, which has been so abundant the past season, has been known for a long time in Connecticut, and it is interesting to note that the insect first made its appearance in the United States in this commonwealth. It is believed to have been introduced from Europe upon young pear trees imported by Dr. Ovid Plumb of Salisbury, in 1832 and during the five years following, several hundred trees were killed by this insect.

In 1848 the insect was known to be present in Massachusetts and New York. In 1871 considerable injury was caused by it in New York and Illinois, and again in 1879 it was destructive in New York State. It was not until 1891, however, that the insect became generally abundant and destroyed many trees in Massachusetts, Connecticut, and Maryland. Since then the insect has appeared in many other states, and it is doubtless distributed throughout the northern states east of the Mississippi river. Many orchards have been so seriously injured that the crop has been a failure and hundreds of trees have been killed outright.

FIG. 37. Pear psylla, adult insect, considerably enlarged. (After Slingerland, Cornell University Exp. Station, Bull. 44.)

FIG. 38. Egg of pear psylla, much enlarged. (After Slingerland, Cornell University Exp. Station, Bull. 44.)

In the season of 1892, Professor M. V. Slingerland of Cornell University made a careful study of the pear psylla, and the facts connected with the early history and life of the insect are taken from his admirable bulletins.*

Relationship to Other Insects.

The pear psylla belongs to a group of insects known as jumping plant-lice, which form the family *Psyllidae*. These insects are closely related to our common aphides, or plant lice, but the adults have the habit of jumping like fleas.

According to a paper by C. W. Mally,† there are about thirty-five species of this family in the United States.

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* Bulletin 44, Cornell Exp. Station, 1892.
Bulletin 108, Cornell Exp. Station, 1896.

† *Psyllidæ* found at Ames, Iowa, Proc. Iowa Acad. of Sciences, Vol. II., p. 152, 1894.

How the Pear Psylla Injures Trees.

Belonging to the order Hemiptera and being a near relative of the plant lice, the pear psylla, like its allies, feeds by sucking the sap or juices from the pear tree. The soft and succulent tissues are evidently preferred and the leaves and new shoots are, therefore, most commonly attacked. Like the plant lice and scale-insects, the psyllids give off "honey dew," which during the past season was very abundant, on account of the large number of insects, and dripped upon the ground and lower leaves of the trees. The "honey dew" makes the leaves appear as if they had been varnished and a black mold (*Fumago*) grows in the "honey dew" giving the trees a blackened or scorched appearance.

FIG. 39. Pear psylla, nymph, considerably enlarged. (After Slingerland, Cornell University Exp. Station, Bull. 44.)

The injury probably comes chiefly from the minute punctures and the loss of sap. Many trees shed their leaves in July, the lower leaves being the first ones to turn yellow and drop. The young fruit also falls from badly infested trees, such trees make little growth, and sometimes new shoots are attacked and wither early in the season.

Appearance and Life History.

The adult insect is about one-tenth of an inch in length and somewhat resembles a miniature cicada or dog-day harvest fly. It is shown in Figure 37. The egg (see Figure 38) is about one-eightieth of an inch long and scarcely perceptible without the aid of a magnifying glass. It is pear-shaped with the small end drawn out into a long thread-like appendage. The larger end is attached to the twig by a short stalk. The eggs are laid in the crevices of the bark or around the buds about the middle of April. These eggs hatch in about three weeks, and the young nymphs gather in the axils of the leaves, and later on the leaf-blades, young fruit, and tender shoots, where they suck out the sap. The nymphs are not very active and unless dis-

turbed move about but little. I have seen many that were almost buried in their own "honey dew." The nymphs molt several times (probably five) and become adults in about one month after hatching from an egg.

According to Slingerland* there are at least four broods each year and probably sometimes five in Maryland. The eggs of the summer broods are laid upon the leaves and have the same appearance as those laid upon the twigs in April.

The nymph or immature insect is at first yellow in color but as it grows takes on a reddish tint and black markings. The full-grown nymph has conspicuous black wing-pads and is shown in Figure 39.

The insect passes the winter in the adult stage on the pear tree, in cracks of the bark and scars where branches have been removed.

Natural Enemies.

Our common lace-winged fly *Chrysopa oculata* and our commonest lady-beetle, the "two-spotted" species, *Adalia bipunctata,* are known to feed upon the pear psylla.

Remedial Treatment.

Slingerland reports that the eggs are difficult to destroy and that many hatched after having been dipped into kerosene. The young nymphs, however, were readily destroyed by kerosene emulsion. In our own tests common soap and water (1 lb. dissolved in 4 gallons water) destroyed the nymphs and many of the adults. The chief difficulty lies in the fact that many of the nymphs are partially or wholly covered by "honey dew" so that they are not reached by the insecticides. It is recommended, therefore, that where possible the application should be made directly after a rain, which washes off the "honey dew." Probably the most vulnerable point in the life history of the insect is during the latter part of April, soon after the first lot of eggs hatch. The young nymphs are readily destroyed, and at this time "honey dew" is much less abundant than later in the season. But in April the grower does not expect that the insect will be especially abundant or do much injury, so does not spray. During midsummer, when the young

* *Loc. cit.*

fruit and leaves are falling, he realizes that something must be done. Even at this late hour the ravages of the insect may be checked in large measure by a thorough spraying with soap and water, or kerosene emulsion.

THE ONION THRIPS.

Thrips tabaci Lindeman.

In the Report of this Station for 1889, p. 180, Dr. Roland Thaxter, then Mycologist of the Station, published this note: "The white blast of market onions is the most serious disease to which onions in the field have been subjected this year, and has been reported from numerous localities and observed in all the onion districts which have been visited. The injury gives the field a whitish appearance, which starts in one or more spots and spreads in all directions. The onions themselves become stunted in their growth, while the leaves are more or less completely dying, according to the severity of their attack;

FIG. 40. The onion thrips *Thrips tabaci*. *a*. adult female; *b*, antenna of same; *c*. young larva or nymph; *d*. full grown larva. All enlarged. (After Howard, Division of Entomology, U. S. Dept. of Agriculture, Yearbook for 1898.)

becoming water-soaked at the base if the weather be at all wet, inducing decay, and generally injuring the keeping quality of the bulbs."

The above description applies very well to the appearance of a three-acre field of onions in Highwood when the writer visited the place on July 24. This field has already been mentioned on page 213 of this Report. At this time the insects had spread over the entire field and the tops of the plants were nearly all white.

The owner said that he should not bother to spray the plants, though soap and water was suggested as an insecticide. And

it was probably not worth while to attempt to save the plants as they had been so seriously injured.

As the onion thrips is a serious pest of the onion crop in Connecticut, and as considerable attention is given this crop in the State, a short account of the insect here may be of some help to the growers.

Mr. Pergande, who has published "Observations on Certain *Thripidae*,"* states that the earliest record that he could find of this insect injuring onions was made by Dr. A. S. Packard in 1872,† while entomologist to the Massachusetts Board of Agriculture. In Packard's paper it is stated that the injuries to the onion crop caused by this insect amount to $10,000 annually in Essex county alone.

Gillette gives an account‡ of thrips that had attacked onions in Colorado in 1892 and 1893 and which he supposed to be a new species, suggesting the name of *Limothrips allii* for it. This species was later described by Miss Beach, who placed it in the genus *Thrips*. The specific name suggested by Gillette was used in Bulletin 83, new series of the New York (Geneva) Agricultural Experiment Station in 1894.

After comparing material of this species with European specimens of *Thrips tabaci* Lindeman, Mr. Pergande finds the supposedly different species to be identical, and Lindeman's name must stand.

The adult female is only about one millimeter in length, of a pale yellow color with darker wings, legs and antennæ. The male greatly resembles the female but is smaller and without wings. The antennæ are seven-jointed. See Figure 40. The larva is smaller than the adult female, without wings, and with six-jointed antennæ. The immature larva is shown on Plate VI, b.

This insect is also known to feed upon cabbage, cauliflower, kale, turnip, melons, pumpkin, squash, cucumber, tobacco, tomato, wheat, and many kinds of flowering plants and weeds.

The species was recorded as an enemy of tobacco by Targioni-Tozzetti§ in 1891, and Howard mentions it in his article on

* Insect Life, Vol. VII, p. 390.

† Second Annual Report on the Injurious and Beneficial Insects of Mass., p. 5.

‡ Bulletin 24, Colorado Agr. Exp. Station, p. 13, and Rept. of the same Station for 1893.

§ Animali ed Insetti del Tobacco, p. 222.

tobacco insects,* but states that it has never been found upon tobacco in this country. The most recent account of the insect is given by Hinds in his excellent monograph of the order.†

The remedies usually recommended are, spraying with kerosene emulsion or soap and water, except in green-houses where tobacco fumigation often serves to hold the insect in check. This proved satisfactory in case of an allied species, *Heliothrips femoralis* Reuter (*cestri* Perg.), that attacked forcing-house‡ cucumbers at this Station a few years ago.

The various species of thrips injure plants by puncturing the green portions and sucking out the sap. The cells thus emptied of their contents become white and shrivelled, thus suggesting the name "white blast" applied to the trouble by the onion growers.

AN INTERESTING LUMINOUS INSECT.

On June 12 the writer received from Prof. W. R. Coe of Yale University a large luminous larviform insect which had been found at Mt. Carmel by Mr. R. D. Gilbert. Though the specimen greatly resembled a larva, it was probably the female of a species of *Phengodes*. Very little is known about the species of this genus especially the females, except that they are among the most striking and beautiful of all luminous insects. It was formerly supposed that these females were the larvæ of certain species of click-beetles (family *Elateridæ*), and in the fifth Report on the Noxious and Beneficial Insects of Illinois, by Wm. LeBaron (LeBaron's 4th), page 99, there is published one of Riley's figures in which the luminous female is shown as the larva of *Melanactes piceus* De G. The same figure was used by Dr. Riley in the American Entomologist, page 202, and labeled "A luminous elaterid larva." The specimen collected by Mr. Gilbert so closely resembled Riley's figure that I have herein reproduced it in part, omitting the elaterid beetle which was originally a portion of the figure. See Figure 41.

On July 8, a similar but much smaller specimen was received from Mrs. C. H. Lyman, Jr., of Waterbury. I was unable to

* Principal Insects Affecting the Tobacco Plant, Year-Book U. S. Dept. of Agriculture for 1898, p. 142.

† Contribution to Monograph of the Insects of the Order Thysanoptera, Inhabiting North America, Proc. U. S. Nat. Museum, Vol. XXVI, p. 79, 1902.

‡ Report Conn. Agr. Exp. Station for 1896, p. 244.

determine whether this was a different species or only a younger example and possibly the true larval form of the same species. Both specimens were kept for a time and fed upon small earth worms which were provided them. Several myriapods were given them but they were evidently not the right kind and were not eaten. Both died before the end of the summer and neither specimen molted nor transformed while in captivity.

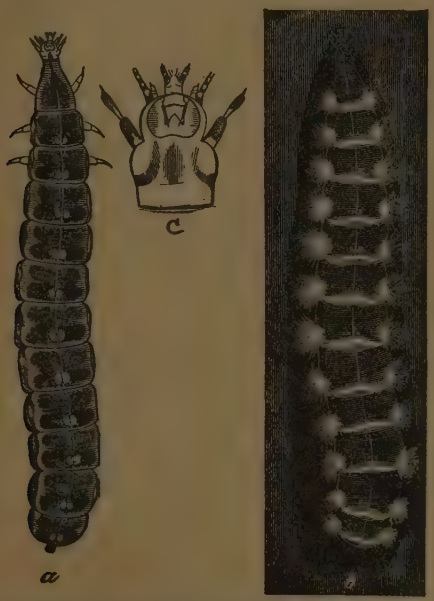

FIG. 41. A luminous insect, probably *Phengodes laticollis*. *a*, appearance in daylight; *b*, appearance in darkness; both natural size. *c*, head of same, enlarged. (After Riley.)

The specimen from Mt. Carmel was probably the adult female and was nearly three inches in length, and nearly one-half inch in thickness in the middle, from which the body tapered in both directions, though but slightly, towards the posterior extremity. The anterior portion tapered considerably to the head, which was small and retractile. Twelve segments, beside the head, made up the body. The body was cream-colored or light yellowish brown, with a slightly darker band along each side and a narrow line along the back. Beginning on the second thoracic

segment, each segment has a pair of oval spots, one either side of the median line. The posterior margin of each segment was somewhat lighter in color than the other portion, and in the dark this margin appeared as a luminous cross-band. Along the side of the body each segment bears a luminous spot from which a greenish white light radiates, as shown in Figure 41. This is undoubtedly the most brilliant and handsome of all the glow-worms. The light was sufficiently bright to enable one to read the coarse print of newspapers. Several attempts were made to photograph this insect by its own light but without success. After long exposure only a feeble image was made on a very sensitive plate. The insect was placed in a box in the dark room with a sensitive plate three inches from the object. After an hour's exposure the plate was only very slightly affected, showing that the light is quite non-actinic.

In 1886, Dr. Riley read a paper before the Washington Entomological Society,* stating his conclusion that the luminous larvæ which had previously been referred to the *Elateridæ*, belonged to the *Lampyridæ* and to the genus *Phengodes*. The next year further notes were presented† regarding the pupation and egg-laying of one of these larviform females.

One of the most interesting accounts‡ of observations upon these curious insects is from the pen of Prof. G. F. Atkinson, now of Cornell University, but formerly botanist and entomologist of the South Carolina Experiment Station. Atkinson describes the female of *Phengodes laticollis* Lec. which he kept in captivity for a long time, and which fed upon *Polydesmus canadensis*. On May 19, males were collected after they had visited the females. These males were only about three-fourths of an inch in length and were not luminous. The females laid yellowish eggs, which were also luminous before hatching. The eggs from one female were not fertilized and therefore did not hatch; the other female deposited fertile eggs which hatched in thirty days.

Prof. J. B. Smith states§ that the larvæ and females of *Phengodes* are among the most brilliant of all our forms and are very rare.

* Proc. Ent. Soc. of Washington, Vol. I, p. 62.
† Idem, Vol. I, p. 86.
‡ Report, South Carolina Exp. Station, 1888, p. 48.
§ Insects of New Jersey, p. 261.

Many of the *Lampyridæ* are considered beneficial as they feed largely upon insects or other forms of animal life.

THE IMPORTED CABBAGE BUTTERFLY OR CABBAGE WORM.

Pontia (*Pieris*) *rapæ* Linn.

The chief insect enemy of the cabbage in Connecticut, and in fact in the northeastern United States, is the imported cabbage worm, *P. rapæ*. The white butterflies may be seen flying about every garden on bright summer days, and the caterpillars may be found feeding upon cabbage and cauliflower wherever these vegetables are grown. The species was introduced into America from Europe in 1858, by way of Quebec, and it has since spread over the entire United States. Formerly a native species, *Pontia oleracea*, attacked the cabbage crop in the northern states, but this species is now very rare and as a cabbage pest has been almost entirely superseded by the imported species, *P. rapæ*.

The cabbage butterfly is yellowish white in color with body and tips of the fore wings black, and a black spot in the center of each fore wing and on the front edge of each rear wing. The egg is a small cone-shaped object fastened by the base to a leaf of the cabbage, mustard or some allied plant. In about six days the egg hatches and the young worm or larva, after devouring the egg-shell, spins a small web upon which it rests while feeding. In about ten days, during which time the worm has been feeding energetically and has molted three times, it becomes full grown and crawls under a board or fence rail and forms a chrysalis. The chrysalis is often found suspended by a silken thread to the under side of fence rails, clapboards of buildings, etc.

About twelve days are required for the transformations to take place in the chrysalis, then the butterfly emerges. The caterpillars feeding upon a cabbage leaf, chrysalis and adult all natural size, are shown on Plate VII.

In northern New England there are three broods each year, and according to Lowe and Sirrine* there are at least four,

* Bulletin 83, New Series, New York (Geneva) Agr. Exp. Station, p. 658.

and possibly five, broods each year on Long Island. The winter is supposed to be passed in the pupa or chrysalis stage.

It has been estimated that this insect causes an annual loss of about one million dollars in the vicinity of New York City.

The chief remedy used by truck growers is to spray or dust young plants with Paris green. As the cabbage plant grows from the inside in heading, there is little danger of its being poisoned even after the head is formed if the outer leaves are removed before cooking or using. But in the home garden, the worms may be suffocated by blowing upon them some fine dust like road dust, Pyrethrum, hellebore, or air-slaked lime. They may also be killed with hot water, kerosene emulsion, or soap and water.

THE NATIVE CURRANT BORER.

Psenocerus supernotatus Say.

Each season a number of currant stems have been killed at the Station by this beetle, though the damage is not very great because new canes are produced freely. Growers do not seem to be very familiar with this enemy, however, and a short account of it is given here for the purpose of acquainting them with the chief facts in its life history.

FIG. 42. Native currant borer *Psenocerus supernotatus*. Adult insect. × 6.

We have two different borers attacking the currant. Besides the beetle just mentioned, the imported currant borer (*Sesia tipuliformis* Linn.), the adult of which is one of the clear-wing moths, occasionally is sufficiently abundant to do considerable injury.

On May 27, the writer noticed that many shoots in the currant plantation were not healthy. Some were even dead, though in leaf, others showed yellow leaves, and in many cases the foliage had wilted. On cutting, examination showed that these canes were tunneled lengthwise through the pith, the tunnel in some cases extending up and down the stalk for several inches. Some of the tunnels were empty with an exit-hole where the borer had escaped. No larvæ were seen, but living pupæ were found in the burrows, and in one an adult beetle. The pupa in each case was near the exit or mouth of the burrow, and is about a quarter of an inch long, and brown in color. Photographs of some of the specimens, together with the injured currant stalks, are shown on Plate VIII. The beetle is very small, being about one-fourth of an inch in length, narrow, and dark brown in color marked with white spots as shown in Figure 42. This beetle belongs to the family of long-horned beetles (*Cerambycidæ*) which includes many of the large-sized borers.

The only known remedy is to cut and burn the infested stalks, and this should be done as soon as they appear sickly, in order to destroy the borer before it escapes from the stalk.

ENTOMOLOGY IN THE REPORTS OF THE CONNECTICUT BOARD OF AGRICULTURE.

As Connecticut was one of the first states in the Union to establish and maintain a Board of Agriculture, and as the Reports of this Board form a series of volumes from 1866 to the present time, except in 1870, when the Board was abolished by act of the legislature, but reorganized the following year, considerable interesting matter regarding the early appearance of injurious insects in the state may be looked for in the Reports of this Board.

The Station library contains a complete set of these Reports. Thinking that a list of the entomological references might be of some value to entomologists, especially regarding the historical side of economic entomology, I have asked Mr. Walden to prepare such a list, which is here published. It also contains one or two references to the Transactions of the Connecticut Agricultural Society, which preceded the reports of the Board of Agriculture. Three volumes of the Transactions are in the Station library.

REFERENCES TO ADDRESSES AND NOTES CONCERNING INSECTS, IN THE REPORTS OF THE CONNECTICUT BOARD OF AGRICULTURE.

PREPARED BY B. H. WALDEN.

1854 Transactions of the Connecticut Agricultural Society, pp. 120.
Joseph Barratt, M.D. Report on the season of 1846.
A few Economic notes on,—
Selandria cerasi on pear trees.
Plant lice on apple trees.
Canker worm, absence of.
Notes on *Clisiocampa Americana* from 1840-1844.
Also gives notes of the dates when he first heard the harvest fly, *Cicada canicularis,* from 1837-1846, page 128.
Similar notes regarding Katydid, *Platyphyllum concavum.*

1866 Report of State Board of Agriculture, page 81.
Mr. Robinson of Hampton. Note on worms on apple trees.
"Fire worm," "Canker worm."
Mr. Barnett of New Haven. Note on treatment of Plum curculio.
Mr. Leffingwell, West Haven. Note regarding peach borer.
Mr. David Lyman, Middlefield. Note on canker worm.
Prof. W. H. Brewer, page 85. Remarks on canker worm.
ichneumon fly.
Hessian fly.
Mr. Barnett, page 88. Remarks on thrips on grape vines.
D. W. Coit, Norwich, page 162. Note regarding thrips on grape vines.
H. S. Chapman, trouble with rose bugs on grapes, cherries, peaches and apples.
T. S. Gold, page 202. Notes on Plum curculio, *Rynchænus nenuphar,* methods of fighting it.
Saperda bivittata. Notes on life history and remedy.
Canker worm, remedy.
Carpocapsa pomonella, remedy.
Peach borer, remedy.
Rose bug, remedy.
Vine fretter or thrips, remedy.
Selandria cerasi, remedy.

1869 Prof. A. E. Verrill, page 72. Address, External parasites of domestic animals.
page 162. Address, Internal parasites of domestic animals.

1871 Prof. S. I. Smith, pages 203-234. Address, Importance of studying insects.
(followed by discussion.)

1872 Prof. S. I. Smith, pp. 345-383. Report of Entomologist to the Board.
Prionus brevicornis, Saperda candidata,
Crioceris asparagi, descriptions and remedies.
Systematic paper on grasshoppers, and a
List of the Orthoptera of Connecticut.

1873 P. M. Augur, page 334. Notes on codling moth, depredations and remedies.
pages 263-268. Discussion regarding the potato bug.

1878 P. M. Augur, page 279. Note on *Saperda bivittata.*

1879 Dr. E. L. Sturtevant, page 132. Address, Some thoughts and facts concerning the food of man.
(insects as food.)

1881 P. M. Augur, page 332. Insect depredations.
A few notes as to remedies for apple borer, canker worm, tent caterpillar and insects that feed upon the foliage.

1882 Alonzo Bradley, page 148. Address, Bee-keeping by amateurs and non-professionals.

1883 P. M. Augur, page 317. A few brief notes on insects.
Discussion on bees: lice, foul brood, Italian queens. Stock in Connecticut.

1884 P. M. Augur, page 290. Note about destroying canker worms.
H. L. Jeffrey, 302. Report for 1884, on Bee-keeping.

1885 Prof. B. F. Koons, page 56. Insects injurious to the apple. 18 pages followed by discussion.
apple maggot.
canker worm.
tent caterpillar.
codling moth.
apple tree borer.
bark lice and plant lice.

1887 Dr. E. H. Jenkins, page 221. Insecticides; Paris green, London purple white arsenic.

1890 Dr. E. H. Jenkins, page 149. Note about spraying to kill the asparagus beetle.

1896 W. E. Britton, page 234. Answering questions regarding asparagus beetle and San José scale.

1898 Geo. T. Powell, page 241. Pear psylla and bud moth discussed in a lecture on fruit culture.

1899 W. E. Britton, 253. Short address on the San José scale, followed by a discussion.

1900 W. E. Britton, page 284. Talk about San José scale followed by discussion about pea louse by Mr. Britton, Mr. Woodruff, and Gov. Hoard.

1901 S. A. Beach, page 132. Address, Diseases and Insects injurious to orchard and field crops.

W. E. Britton, page 193. Address, Insects and their relation to Agriculture. Illustrated by lantern slides.

1902 W. E. Britton, page 245. Address, Mosquitoes and malaria.

NOTES.

Mexican Jumping Seeds.—On July 31, some of these curious seeds were received from Mr. F. Chillingworth, a resident of New Haven, who for two years has been connected with a manufacturing business in the City of Mexico. These seeds are also called "jumping beans" and "devil's beans" but they are not real beans as they belong to the plant family *Euphorbiaceæ* instead of to the *Leguminosæ*. Mr. Chillingworth writes that these seeds are considered poisonous by the Mexicans when taken into the human stomach, and this also is mentioned by Dr. C. V. Riley* as being an established fact.

The seeds received were three-celled, and seem to answer the description of the seeds of the species of *Sebastiania,* given in Dr. Riley's article.

It is known that two species of moths infest several species of seeds causing these "jumping seeds." The jumping is caused by the movement of the grub or larva inside the seed, and the movement is induced by the rise in temperature when these seeds are held in the hand.

Carpocapsa salitans Westw. and *Grapholitha sebastianiæ* Riley, are the species recorded from Mexican "jumping seeds."

"Disparene" a remedy for the asparagus beetle.—In the second report of the State Entomologist, 1902, page 172, there is a short account of the common asparagus beetle *Crioceris asparagi* Linn., and hellebore was mentioned as a safe and fairly satisfactory insecticide to use upon the young plants. During the latter part of the season the insects were very abundant,

* Proc. Entomological Society of Washington, Vol. 2, p. 178.

and severely injured some of the large plants. At this stage, hellebore did not prove sufficiently effective to warrant a continuance of its use. On June 3, the asparagus plants on the Station grounds were all sprayed with "disparene," one and one-fourth pounds in twenty gallons of water. There is very little leaf surface to cover on the asparagus plant, and for that reason sprays have not always been satisfactory when applied to the large plants. "Disparene" contains arsenate of lead as its poison, and this material is noted for its sticking qualities. In this trial the plants were very thoroughly sprayed, the nozzle being directed toward the plants from all sides in succession, and every portion well covered. On June 4, many dead beetles and larvæ were found on and under the plants. Some were alive and feeding. A careful examination was made of the plants on June 9, and only a few living larvæ could be found. Nearly all of the insects had been killed and the plants were far cleaner than they had been since beginning to grow in the spring. The beetles did not again become very abundant on the plants during the summer.

Any preparation of arsenate of lead would probably answer quite as well.

Abundance of Cingilia catenaria Dru.—Caterpillars of this species were received from Terryville on July 12, with the statement that they were devouring the leaves of sweet fern, hazel, apple, oak, chestnut, sumac, huckleberry, and other low-growing shrubs. The caterpillar is a "looper" or "measuring worm," about one and three-fourths inches in length when full grown, and of a yellow color marked with black. There are several indistinct hair lines extending longitudinally along the back and the ventral surface. Each segment is marked on either side with two distinct black spots somewhat triangular in shape, with a small dot between and just below the larger ones, marking the position of the spiracle. The adult is a white moth dotted with black, and is know as the "chain dotted geometer."

The caterpillars became full-grown about the middle of August and pupated, forming a very beautiful loose net around the chrysalis which was itself beautifully marked. Adult moths appeared a month later.

As the caterpillars usually feed upon wild shrubs, trees, and plants which are not cultivated or prized by farmers, little damage is done by them. Should they attack cultivated crops, however, spraying with arsenical poisons would be the remedy.

Xyleborus celsus Eich.—Mr. C. B. Burrows brought two specimens of this beetle to the Station on September 14. He had taken them from their tunnels in the trunk of a hickory tree in New Haven which had been injured by the hickory bark borer, *Scolytus quadrispinosus*. *X. celsus* belongs also to the *Scolytidæ*, a family including some of the most destructive tree borers.

Strawberry leaf-roller attacking dewberries.—On July 1, Mr. Walden visited a field of dewberries in Highwood, where many leaves had been rolled up by some insect. The owner regarded the injury as rather serious and thought that the fruit was considerably smaller on account of the attack of the insect. In a field of several acres many plants each showed as many as a dozen leaves rolled in a characteristic manner. The insect proved to be the strawberry leaf-roller, *Ancylis comptana* Frœl., an insect sometimes causing serious injury to the strawberry. It apparently attacks several allied plants. Spraying with arsenical poisons would, of course, forestall serious injury.

Fumigating to kill San José scale on fruit trees growing under glass.—Fruit trees are sometimes grown under glass in this country in the same manner that they are grown in Europe. In order to save room the trees are usually trained against a brick wall or against the glass into the shape of a fan. In Hartford, peach and nectarine trees trained in this manner became infested with the San José scale. The house was 90 feet long and 11½ feet wide. We were asked to examine the house, and later in December fumigated it with hydrocyanic acid gas. Many of the trees were thoroughly infested and some small branches had been killed, yet the trees were not winter-killed like similarly infested trees out of doors. A subsequent examination showed that the scales were all killed. Reinfestation will doubtless occur again, as the house is open through the summer and there are many infested trees in the vicinity.

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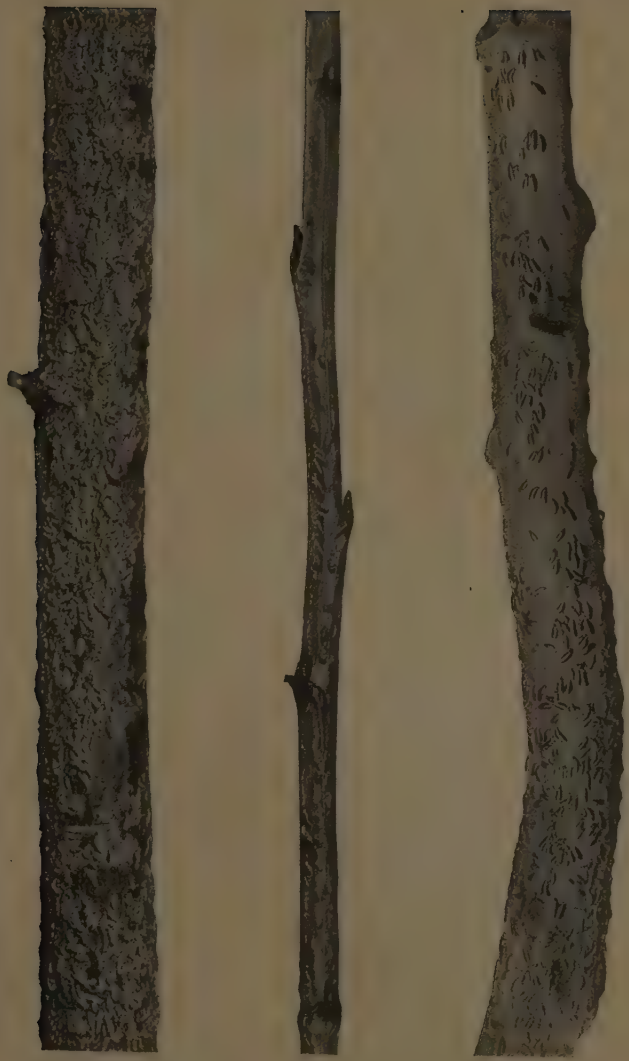
SCURFY BARK-LOUSE *Chionaspis furfurus* Fitch.
Females on currant. Natural size.

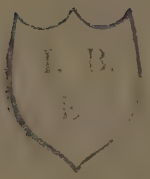


OYSTER-SHELL BARK-LOUSE *Mytilaspis pomorum* Bouché.
Females on poplar. Natural size.

a. Trees cut back ready for spraying. Orchard of Barnes Brothers, Yalesville.

b. View of orchard at Southington. Sprayed trees at the right.

ORCHARD TREATMENT AGAINST SAN JOSÉ SCALE-INSECT.


I. B.
E.

a. Cooking the lime, sulphur and salt mixture at Southington. A Kinney "Safe" engine furnishes steam to boil the mixture in barrels.

b. View in Barnes Brothers' orchards showing elevated storage barrels and spraying barrel and pump mounted on stone drag.

APPARATUS FOR MAKING AND HANDLING THE SPRAYING MIXTURE.

a. Outfit used in Southington Experiments.

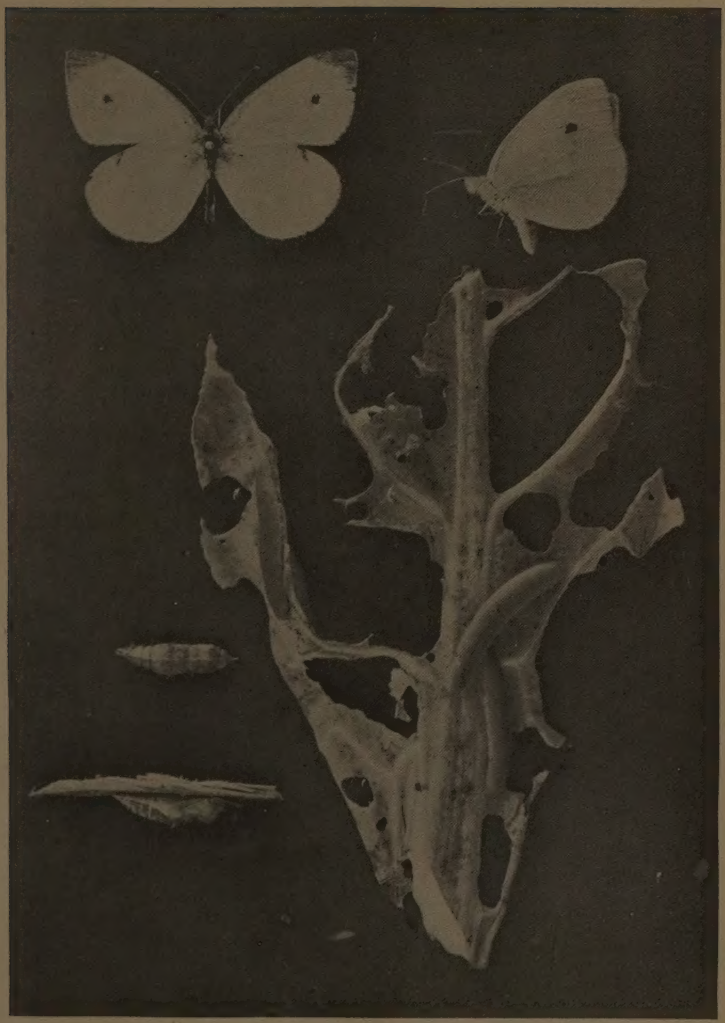
b. Outfit employed by Barnes Brothers at Yalesville.

SPRAYING WITH LIME, SULPHUR AND SALT.

a. Apple twig infested with apple aphis, *A. pomi* DeGeer.

b. The Onion Thrips, *Thrips tabaci* Linde. Immature nymph: greatly enlarged.

c. Egg-mass of the Chinese mantid *Paratenodera sinensis* Saus. Natural size.



THE IMPORTED CABBAGE WORM *Pontia* (*Pieris*) *rapæ* Linn.
Larva, pupa and adult stages. All natural size.

a. Healthy and infested stalks.

b. Infested stalks split open to show burrows: a pupa and the exit are shown at the left. Natural size.

c. Pupa much enlarged.

NATIVE CURRANT BORER *Psenocerus supernotatus* Say.

I. B.
E.